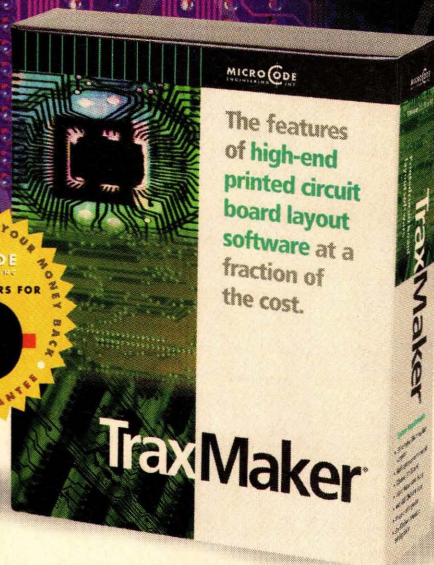
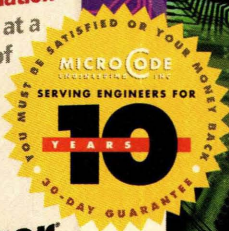
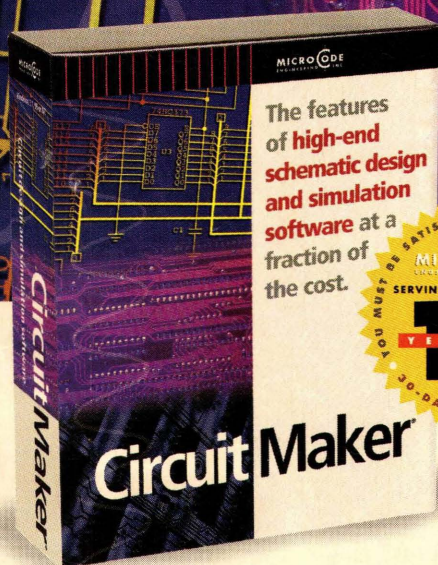


High-end features. Low-end price.

\$299

CircuitMaker 6:
Schematic design
and simulation
software



\$299

TraxMaker 3:
Printed circuit
board layout
software

CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. Call now for your free functional demo.

CircuitMaker 6 is a powerful schematic design and simulation program featuring:

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

TraxMaker 3 is a powerful printed circuit board layout program featuring:

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unroutable capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

MICROCODE
ENGINEERING INC

For free demo software, or to order, call 1-800-419-4242

927 West Center Street • Orem, UT 84057 • Phone (801) 226-4470 • Fax (801) 226-6532 • www.microcode.com

©1998 MicroCode Engineering, Inc. All rights reserved. CircuitMaker, TraxMaker, SimCode and MicroCode are registered trademarks of MicroCode Engineering, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.

CIRCLE 133 ON FREE INFORMATION CARD

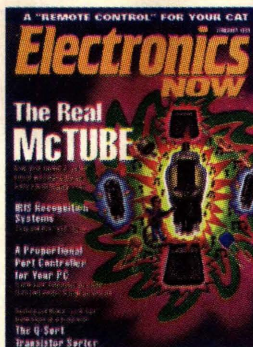
CONTENTS

FEBRUARY 1999

ON THE COVER

31 THE REAL McTUBE

Whether you miss the good old days or are just looking for a different sound for your music, this month's cover project is one you won't want to pass up. It is an easy-to-build vacuum-tube-based amplifier that's perfect for the "retro" musician. It also makes it easy to experiment with the vintage sound and mellow distortion that tube amplifiers produce, and could perhaps settle the question, at least in your own mind, of whether tubes are really better than semiconductors. — *Fred Nachbaur*



BUILD THIS

36 BUILD THE Q-SORT

A quick and easy way to test and sort your growing collection of bipolar transistors.

— *Larry Ball*

44 AN AC PROPORTIONAL-VOLTAGE CONTROLLER FOR YOUR PC

Give your computer the power to do more than just turn connected devices on and off.

— *Neil Bungard*

DEPARTMENTS

6 COMPUTER CONNECTIONS

Portable embedded C. — *Jeff Holtzman*

16 SERVICE CLINIC

Monitor power-supply problems. — *Sam Goldwasser*

21 EQUIPMENT REPORTS

Micro 2000 Centurion Year-2000 solution for the PC.

54 TECH MUSINGS

Measuring luminosity, hydrogen absurdities exposed, and a "remote control" for your cat. — *Don Lancaster*

TECHNOLOGY

13 PROTOTYPE

Microbatteries, robot surgeons, an unbreakable code, and more.

41 IRIS RECOGNITION SYSTEMS

They put the "eye" in ID. — *Bill Siuru*

52 A STAMP OF APPROVAL

The history of radio and electronics can be seen in the postage stamps of the world.

— *James E. Bie and Raymond Schuessler*

AND MORE

2 EDITORIAL

3 Q&A

22 LETTERS

23 NEW PRODUCTS

25 NEW LITERATURE

94 ADVERTISING INDEX

94 ADVERTISING SALES OFFICE

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) February 1999. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1998 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET,
Editor-in-chief and publisher

ADRIA COREN, Vice President

KEN COREN, Vice President

EDITORIAL DEPARTMENT

CARL LARON, editor

JOSEPH J. SUDA, technical editor

EVELYN ROSE, assistant editor

MICHAEL A. COVINGTON, N4TMI
contributing editor

SAM GOLDWASSER, service editor

JEFFREY K. HOLTZMAN
computer editor

FRANKLIN J. MILLER, audio editor

DON LANCASTER, contributing editor

JANINE ABITABILE, editorial assistant

ART DEPARTMENT

ANDRE DUZANT, art director

RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT

RUBY M. YEE, production director

KATHRYN R. CAMPBELL
production assistant

KEN COREN
desktop production director

MELISSA GIORDANO
desktop production

CIRCULATION DEPARTMENT

THERESA LOMBARDO
circulation director

GINA GALLO
circulation assistant

REPRINT DEPARTMENT

CHRISTINA M. ESTRADA
reprint bookstore

Typography by Mates Graphics

Electronics Now is indexed in
Applied Science & Technology
Index, and *Readers Guide to Peri-*
odical Literature, *Academic Ab-*
stracts, and *Magazine Article*
Summaries.

Microfilm & Microfiche editions are
available. Contact reprint bookstore
for details.

Advertising Sales Offices listed on page 94.

Electronics Now Executive and
Administrative Offices

1-516-293-3000

Subscriber Customer Service:

1-800-999-7139

700AM-600PM Monday-
Friday MST

VISIT US ON THE INTERNET AT
www.gernsback.com

EDITORIAL

Here We Go Again!

This month's editorial is going to bore some of you and annoy others. That's fine, because it is aimed at everyone else. The topic is the Internet.

If you are already on the Internet, you don't need to read what follows as it will just bore you and there are plenty of other interesting things to discover in this month's issue.

If you've made your mind up that the Internet is the biggest waste of time ever invented, inherently evil, or just not for you, you don't need to read what follows. While I can be persuasive, I can't change a closed mind.

OK, now that they are gone, we can talk freely. The first thing you might be wondering about is why am I so high on the Internet. I guess the reason is that I have come to depend on it in ways I could not have imagined just a few short years ago.

The last time I talked about the Internet, I dealt with how it can help electronics hobbyists get more out of their pursuits. This time, I want to deal with how it has impacted me personally.

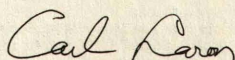
You want examples? Here goes: In addition to my duties here at **Electronics Now**, my wife and I own a small collectibles business. We do a lot of traveling in connection with that, and I almost always make our hotel reservations online. One huge advantage is that we get an instant confirmation, including quoted rates, that we can print out and take with us. Having that in hand helps make sure that the check-in procedure goes smoothly. If a flight is involved, we also can check airline schedules and fares and even make the reservations online.

We've also established our own Web site. It is small and nothing fancy, but it gets the job done and has more than paid for itself.

Well, you might say, that's fine for you, but I don't have my own business so what's in it for me? Okay, here's more: An elderly member of my family needed help with her tax returns last year. The problem was she did not have the forms, and we discovered the situation too late to get them by mail. Up to the Internet we went. In minutes we had found the forms we needed (both state and federal), downloaded them in Acrobat format (so that they retained their original formatting), and printed them out—complete with the instruction booklets.

We have begun to do some preliminary research into purchasing a new car (both of ours have pretty high mileage at this point). There are sites on the Internet that provide complete details on just about every car sold today, including available options and packages. They don't only tell you what's available and how it is sold, but they also provide both sticker and invoice pricing so you are better equipped when you face off with the salesman. Some will even give you the book value of your current car (after asking you about mileage, equipment, and condition) if you are looking to trade it in.

I could go on and on, and I have, but you get the idea. The Internet is about information for your hobby, your business, and your personal life. If you think there is nothing on the Internet for "you," it is likely you've never been there or just haven't looked very hard.



Carl Laron
Editor

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS

CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

Swim-Race Starting Signal

Q I would like to build (cheaply) a pulse-tone starting signal and strobe light for starting swim races. It also should be suitable for use with a PA system. It should produce a $1/4$ -second pulse of tone and be ready to fire again immediately in case of a false start. The rules also require a strobe flash simultaneous with the tone. — L. T., Greenville, SC

A Figure 1 shows a circuit you can try. It uses a 556 dual timer IC. First, R1, R2, and C1 ensure that the 556 receives only a narrow starting pulse no matter how long you hold the button down. After being pressed, the button is inactivated for about two seconds while C1 recharges, thus ensuring that an unsteady hand on the button will not produce multiple signals.

The first timer in the 556 then stretches the pulse to exactly $1/4$ second (well, ours measured 248 milliseconds; yours will differ depending on the exact values of R3 and C2). The $1/4$ -second pulse activates the second timer, which is a 500-Hz audio oscillator. The audio can be fed into line-level and microphone-level inputs on your PA system; R7 controls the loudness. If the PA system you want to use this circuit with only has one microphone input available, try the hookup in Fig. 2.

The pulse also triggers Triac TR1, which fires an ordinary photographic flash. You can use any electronic flash unit, even the cheapest you can find at a flea market, since auto exposure and other fancy features aren't needed; in fact, if your flash has auto exposure, you should set it to manual in order to get the brightest possible flash. Be careful when making connections, since some cheap battery-operated flashes place as much as 300 volts across their terminals. You'll be using the flash terminals that normally connect to the switch inside the camera shutter mechanism; you can get suitable connectors at camera stores. If you want

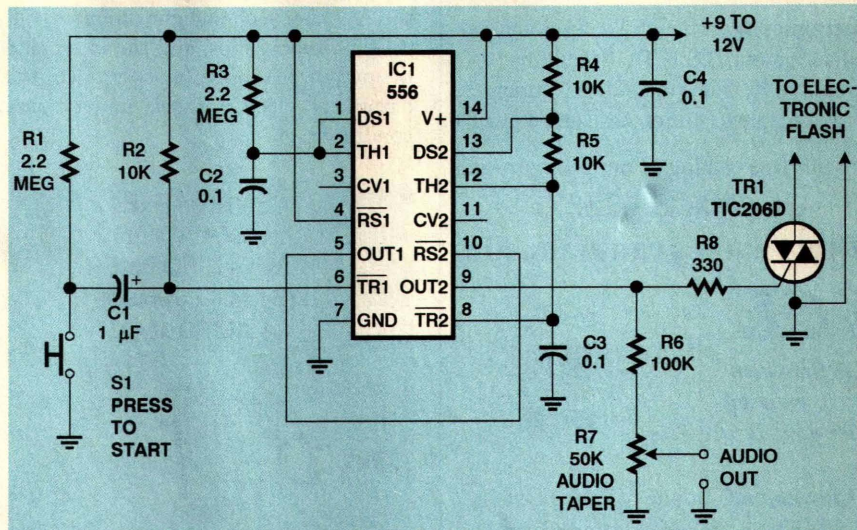


FIG. 1—THIS CIRCUIT PRODUCES an audio beep and a flash of light to signal the start of a race. It can be used with any photographic flash unit.

to build your own xenon flash, see the May 1996 installment of this column.

The Triac specified here, a TIC206D, is a 400-volt sensitive-gate unit; suitable substitutes include the 2N6073A, ECG5608, and NTE5608. Other Triacs may fail to trigger in this circuit.

How soon you can give another signal after a false start depends on the flash recycling time, typically 10 seconds with fresh batteries. The ready light on the flash unit will tell you when it's ready. Keep a spare set of batteries on hand for the flash so that you can replace them in the middle of a swim meet if needed.

Musical ICs

Q I am interested in purchasing some musical integrated circuits for a project but can't find the manufacturers of the chips. Can you help? — V. S., Elgin, IL

A You're probably thinking of the melody generator ICs made by Holtek (1342 Ridder Park Drive, San Jose, CA 95131; Web: www.holtek.com) and dis-

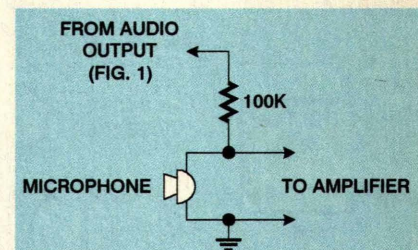


FIG. 2—IF YOUR PA SYSTEM only has a single microphone input, you can use this hookup to couple the audio from the circuit in Fig. 1 to it.

tributed by Tech America (P.O. Box 1981, Fort Worth, TX 76101-1981; Tel: 800-877-0072; Web: www.techamerica.com) and Digi-Key (701 Brooks Ave. South, Thief River Falls, MN 56701; Tel: 800-DIGI-KEY; Web: www.digikey.com). Figure 3 shows one of the many circuits you can use. Tunes available range from "Happy Birthday" to "Music Box Dancer." According to Digi-Key, Holtek has not licensed the rights to the music; if a song is copyrighted and you want to use it commercially, you have to contact the copyright holder or appropriate agent yourself.

Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

NEW! -Electronics Workbench Professional 5.0
included in our B.S.E.T. curriculums
-Approved by more than 200 Companies,
VA and Dantes, (tuition assistance avail.)

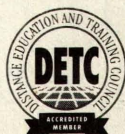
For your free catalog of our programs dial

1-800-955-2527

<http://www.grantham.edu>

GCE

*Your first step
to help yourself
better your future!*



Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

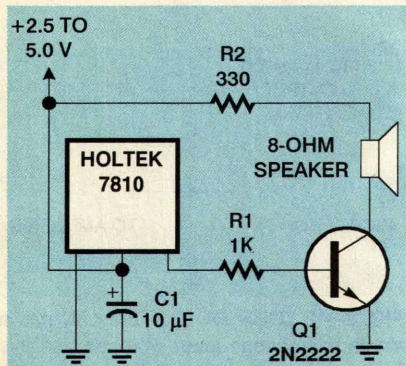


FIG. 3—HOLTEK ELECTRONICS makes a line of melody playing ICs. Here's how they are typically connected.

Holtek also makes numerous other chips such as remote-control circuits, speech synthesizers, and sound generators for use in toys. They're worth getting acquainted with.

Build an Isolation Transformer?

Q I am looking for plans for building a variable isolation transformer that can handle up to 10 amps. — M. B., Montegut, LA

A There's not much to build, since a variable isolation transformer consists of one or at most two components (plus any switches and circuit breakers you might add), and you might as well buy it ready-made. Figure 4 shows what's involved.

This is an extremely useful instrument to have on your workbench. The isolation transformer makes it safe to use modern, grounded test equipment when working on circuits not isolated from the AC line, such as light dimmers, old AC-DC tube radios, and the input side of any power supply. It also reduces the hazard of electric shock under some conditions.

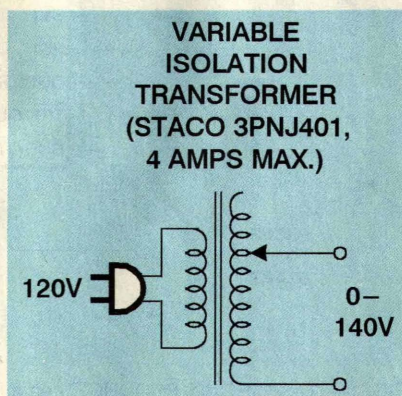


FIG. 4—ISOLATION TRANSFORMERS make it possible to safely work on a wide variety of line-powered equipment. Here are two typical circuits.

The ability to vary the line voltage comes in handy for testing intermittent malfunctions that depend on low line voltage or on overheating (which increases when the voltage is higher than normal). It also lets you apply voltage slowly to old equipment that contains electrolytic capacitors, making it possible to recondition the capacitors rather than blowing them up. Variable autotransformers are often called Variacs, a name that is actually a trademark of General Radio.

Especially because you require 10-amp capacity, these transformers are very expensive and you can save a lot by watching surplus sales, auctions, and hamfests, and by settling for a lower amperage (2 amps is sufficient for most equipment). Unless you get an unusual bargain, you're looking at a \$200 to \$500 project. Surplus transformers are available from Surplus Sales of Nebraska (1502 Jones St., Omaha, NE 68102) and C and H Sales Co. (2176 E. Colorado Blvd., Pasadena, CA 91107). Power transformers can be purchased new from

Allied Electronics (7410 Pebble Drive, Ft. Worth, TX 76118), and many other industrial-electronics distributors.

CD-Changer Problem Solved

Q In your October column, a reader was looking for a way to control his 28 Sony 200-disc CD changers to run an automated radio station.

I have designed controllers for both Pioneer and Sony CD mega-changers as well as other related devices. My units connect to your PC's serial port and convert simple ASCII commands into the control language that the CD changers need.

Please refer your reader to my Web site, www.wintektx.com, as it is very unlikely that Sony will be responsive to his requests for data. — Alan Freeman, Wintek Software, P.O. Box 330655, Ft. Worth, TX 76163

A Thanks for writing! More people need to be in the business you're in—bridging the gaps between pieces of digital equipment from different manufacturers. It's an area full of opportunities for people with ingenuity and knowledge.

Bulk Video Eraser Plans

Q In response to the reader whose letter in the August column asked for a good degausser for erasing magnetic media:

A good-quality degausser that can be used for extended periods of time to erase magnetic tapes and disks and demagnetize tools and ball and roller bearings can easily be constructed from two microwave-oven power transformers.

The core consists of two metal sections, a straight part and a part shaped like the letter E. Grind through the two welds that hold the straight section of the core to the open end of the "E." Then remove the windings and magnetic shunts leaving only the "E" portion of the core. Discard the secondary windings and place both primary windings on the same "E." (If your two transformers are not identical, you will probably be able to fit both windings on one "E" but not the other.) Tie the coils down to prevent movement, then varnish them to stick them down tight. Connect the two coils in series. With the "E" open the inductance will be lower, which is why you need two coils in series to prevent excessive heating.

The alternating magnetic field comes out the ends of the "E." The electromagnet can

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci.electronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio.amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org.

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Claggk, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

be mounted in a nonmagnetic box with the ends of the "E" flush with one side. Mine will erase diskettes on one pass and demagnetizes almost anything I have used it on. Heating has never been a problem for me, but if it needs to be on for a long time you can add a muffin fan and some vents. — Lloyd Hartenberger, Chester, IL

A Thanks very much for sharing this. Several other readers wrote to express dissatisfaction with RadioShack's bulk videotape eraser, which cannot be operated more than about one minute without overheating.

In general, adapting transformers or motors is a good way to build AC elec-

tromagnets. We have not actually built the device you describe, but your design seems sound. Put a fuse or, better yet, a light bulb in series with it when first powering it up, since if one of the windings is wired backward, the inductance will be too low and the device will draw excessive current. Make sure the windings are in series and are wound in the same direction.

To demagnetize anything—be it a tape or a piece of metal—first apply power to the electromagnet, then bring the object up to the electromagnet and move it away again before removing power. When the coil is powered off, there is a magnetic pulse that can mag-

netize (rather than demagnetize) objects in the immediate vicinity.

Laptop Schematic Needed

Q *I'm trying to fix a Toshiba T3100SX laptop computer and can't get a circuit diagram from anywhere; I've checked with many possible sources, including Sams. Can you help? — J. M. L., Sept-Iles, Quebec, Canada*

A Unfortunately, manufacturers of computers don't normally publish schematics, and the entire motherboard is generally treated as one (expensive) replaceable part. The few times I've fixed laptops, I've done it by educated guesswork, checking failure-prone components such as connectors and fuses without analyzing the whole circuit.

You can get some computer schematics, mainly for 1980s models, from Howard W. Sams (2647 Waterfront Parkway, Indianapolis, IN 46214; Tel: 800-428-7267; Web: www.hwsams.com), and some others, including IBM PS/2s and LaserJet printers, from Eagan (contacted through Sams). They aren't cheap; it takes a lot of work to analyze an undocumented circuit and publish the results.

However, as you discovered, neither of these companies covers laptops. However, spare parts and some service assistance for Toshiba laptops is available from Xyratex (formerly Matrix Components), 13581 Pond Springs Road, Austin, TX 78729; Tel: 512-258-7590; Web: www.matrixintl.com; and several other suppliers that you can locate by going to www.yahoo.com and searching for "Toshiba laptop parts." These companies often do "exchange repairs," where you send in a defective motherboard or disk drive and get a repaired one in return.

Lost Sansui?

Q *Answering my question in the August issue, you described a Sansui QRX-5500 as a QRX-3300 and gave the wrong address for Sansui. What is the right address? — R. S. N., Marathon, FL*

A Sorry—it looked like 3300 in your handwritten letter. In any case, Sansui service manuals are hard to find, and the Sansui office in Carson, California, has apparently closed. Sansui TV and VCR

(continued on page 11)

Portable Embedded C

IT SEEMS THAT WHENEVER THE C PROGRAMMING LANGUAGE BUMPS UP AGAINST THE WORLD OF EMBEDDED SYSTEMS, SOMETHING GROTESQUE USUALLY EMERGES. ALL SORTS OF NONSTANDARD LANGUAGE EXTENSIONS APPEAR, WHICH HAS

several effects.

First, any hope of portability is shot. This means that once you choose a hardware platform and write your code, you're pretty much locked in to that platform. If you want to switch to a different microcontroller family, you can pretty much count on rewriting most of your code from scratch.

Second, dialectical profusion occurs. From a software engineering point of view, knowledge reuse is important. Proliferating dialects degrade the knowledge base. You end up having to clutter your mind with numerous low-level product nuances—make that incompatibilities.

What if you could reduce those effects? What if you could have a standard language that covered most of what people do in embedded systems? What if you could increase your code reuse factor from maybe 20% to 80% or even more? And what if you could do it all in a widely used language?

Suppose you took Standard C, as defined by ANSI and ISO standards, and added to and subtracted from it to achieve an embedded-systems control language. Well, you might ask, hasn't that been already done lots of times? Doesn't that just add to the growing family of dialects that are already out there?

Well, suppose we alter the paradigm a little. Most C implementations adapted for embedded use take the core language, then add all sorts of proprietary exten-

sions to handle specific capabilities of the specific target platform. You can't *not* do that; those specific capabilities are what lead you to choose that platform in the first place.

But suppose we alter the strategy. Suppose we abstract certain common features out in a platform-independent way. Then we use language itself to mask the differences. But how can you do that with such a wide variety of different controller architectures? And how can you do it and still remain true to the Standard C?

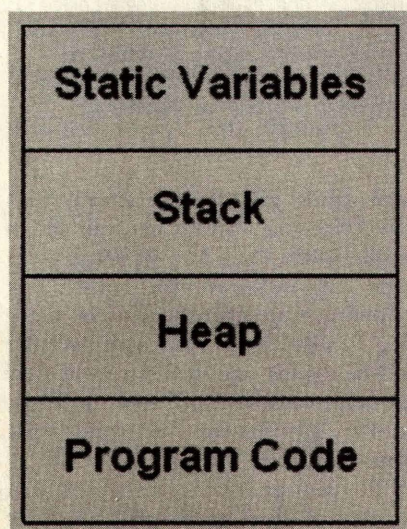


FIG. 1—THE STANDARD C MEMORY MODEL does not distinguish among the different types of memory. It is essentially one contiguous memory space.

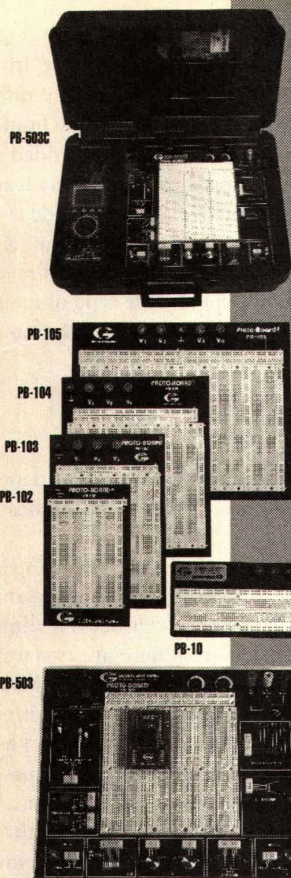
Strictly speaking, you can't. You end up creating yet another dialect. But there's no getting around that. I contend that it's possible to create a dialect that remains true to the spirit of C, but is optimized for use with embedded systems, yet is not tied to any one microcontroller device or architecture. The following is a start on my design for such a language.

Modeling Memory

Standard C has a very weak model of the actual hardware that it runs on. Basically, it acknowledges the existence of memory—and that's it. It doesn't even distinguish among different types of memory. Figure 1 depicts that model. Basically there is a memory space with four areas: program code, heap, stack, and static variables. These four memory areas could be a single contiguous chunk of RAM or four physically separate address spaces. C doesn't care. Typical non-embedded systems use that type of layout in RAM, where the size of the static and code chunks are fixed when the program is compiled, and the size of the stack and the heap can vary at run-time. The heap grows up and the stack grows down. Of course, careful design and testing are required to ensure that they never overlap.

But in embedded systems programming, we do care about those kinds of things, and more. For example, most embedded systems put a premium on RAM. Program code must execute from some sort of read-only memory, and RAM must be allocated very carefully.

Another weakness of the model in Fig. 1 is its ignorance of any other facet of the underlying architecture. Don't get me wrong; that's also a strength—it is what has given C its extraordinary longevity and portability. However, I contend that



Genuine Proto-Boards®

The benchmark in quality & reliability

If the breadboard you're using is not from Global Specialties, it's not a genuine Proto-Board®. And unless it's a genuine Proto-Board®, it's not built with the unmatched quality and craftsmanship only a Proto-Board® can offer. Don't compromise your best design efforts by using a cheap imitation. Put your trust in the name brand that has provided engineers and educators with maximum value for over 30 years - Proto-Board®.

Global Specialties offers powered and non-powered Proto-Boards®, designed to meet the most demanding prototyping applications. Select from a wide range of interlocking breadboards from our patented EXP and QT series sockets, or if it's test instruments in a desktop design workstation you require, select from a number of models designed to meet your technical, as well as economical needs. Each product is available either assembled or unassembled.

There's only one Proto-Board®, and it's made by Global Specialties. Proudly made in the U.S.A.



GLOBAL SPECIALTIES
DESIGN & PROTOTYPING

800-572-1028 • FAX 203-468-0060 • www.globalspecialties.com

CIRCLE 131 ON FREE INFORMATION CARD

**Read Only
Memory (ROM,
FLASH)**

**Read/Write
Memory (RAM)**

**Nonvolatile
Memory
(EEPROM)**

FIG. 2—IN THE PORTABLE EMBEDDED C MEMORY MODEL, the three different types of memory are explicitly acknowledged.

we can make the model a little more robust without giving up anything in the way of portability. Figure 2 shows the first step. (Flash is listed as read-only memory because from the point of view

of a program executing in flash, it is read-only.)

The point here is to acknowledge explicitly the existence of these types of memory and provide language-level

support for them. Doing so has a subtle but liberating effect. It allows you to declare variables and constants that exist in various types of memory, and let the compiler handle the details invisibly and automatically.

For example, C has the concept of type qualifier, which in Standard C contains only the keywords const and volatile. The compiler will (or should) prevent any attempt to alter an object declared const. In addition, it's a sign to downstream processes that such an object could be placed in ROM. However, it's not explicit, and it carries two interpretations, which are really independent. So let's add three type qualifier keywords: ram, rom, nvram; and give them the same scope of usage as the other members of type quali-

TABLE 1—PORTABLE EMBEDDED C PRAGMAS

Key	Parameter(s)	Type	Example
Family	s	string	"AVR" "8051"
Device	s	string	"8515"
MemoryModel	s	enum	tiny, small, compact, medium, large, huge
MemorySize	ram=i, rom=j, nvram=k	long, long, long	
Stack	i, j	long, long	size, initial value
Heap	i, j	long, long	size, initial value
Clock	l	long	frequency in Hz
Precision	l	enum	8, 16, 32

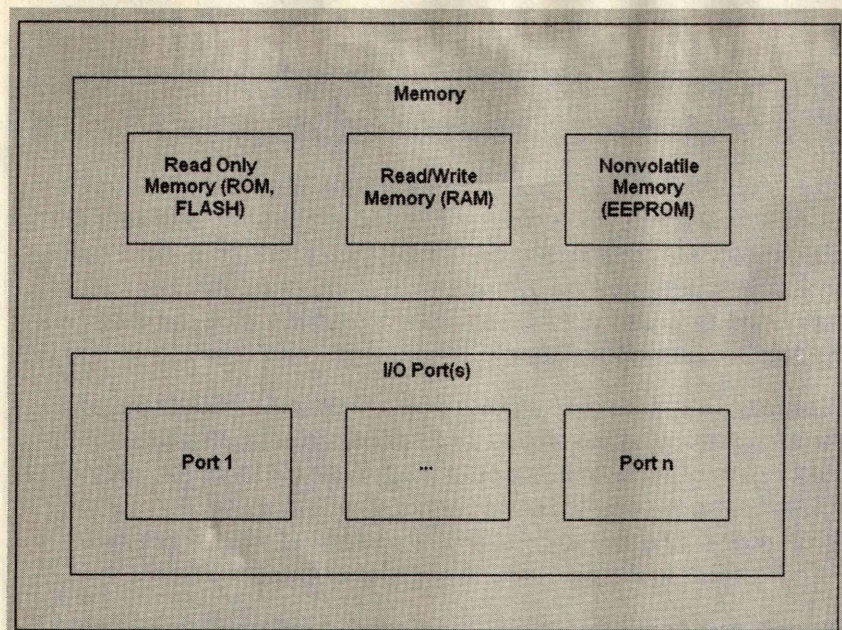


FIG. 3—HERE'S HOW THE PORTABLE EMBEDDED C memory model looks after we add I/O ports to it.

fier. With these keywords, we can thus specify where any given constant or variable is to be located. For example, we could define average as an integer that is stored in RAM:

```
int ram average;
```

or in EEPROM:

```
int nvram average;
```

From a language standpoint, this cleans up the messy process of reading from and writing to EEPROM. Let the compiler handle the dirty details; let the programmer concentrate on solving his application problem. At the application level, reading and writing a chunk of nonvolatile storage is the point; the mechanics of doing so on different processors is not.

However, there are processor-specific things we need to be able to handle in a processor-independent way. For example, most processors have what is called an interrupt vector table. This is a table of addresses, one each for each interrupt supported by the device.

From a C language point of view, an interrupt vector table is nothing but a table of pointers to functions. The catch is that we need to be able to specify the exact location in memory where the table is located (as well as the type of memory). Often the table begins at location zero—but not always. So we will allow each of our three type qualifiers to

take an optional bracketed parameter, which specifies the starting address of the object, like so:

```
int rom[0] IntVecTab[24];
```

By itself, that's pretty useless, because an uninitialized interrupt vector table in ROM must be preinitialized to the desired values, otherwise they'll never get there. So let's assume that we want to initialize the first three vectors to functions named f1, f2, and f3. Standard C provides a simple means of initializing an array, as follows:

```
int rom[0] IntVecTab[24] =
    {&f1, &f2, &f3};
```

That syntax tells the compiler to put the addresses of f1, f2, and f3 into the first three locations of IntVecTab.

Syntactically, the two preceding examples are incorrect. The table is not an array of integers, as declared. It's really an array of function pointers. The syntax is messy and is left as an exercise for interested readers.

Now we can declare any type of variable or constant at a specific location in a specific type of memory. What happens if we declare a "variable" in ROM? There are several possibilities. Internally, the compiler could implement it as a constant and provide a warning or error message on any attempt to write to it. Or the compiler could simply not allow it at all.

Similarly, from where does code exe-

cute? Abstractly, it could execute from any of the three types of memory. However, a specific platform may limit it to only one or two. Our embedded C language must therefore provide a means of specifying where executable code is to be located. With the ram, rom, and nvram keywords, the problem is already solved. We just specify the type of memory as part of the function declaration or definition. For example,

```
ram int f(int i);
```

specifies a function f, which takes an integer and returns an integer, and resides in RAM.

It would be nice not to have to specify the storage type for every single function, so let's create a preprocessor directive to set a default. There are two ways to proceed. We could create a whole new directive, or use the #pragma directive, which is intended to handle platform specifics. Using #pragma increases portability, but clutters up the syntax. A related issue is whether to create three directives (one for each type of memory), or one directive with parameters. I really dislike cluttered syntax, but I have made a commitment to minimizing changes to the language. So let's use #pragma and parameters. The complete syntax is:

```
#pragma SegmentDefault [code | data
    | variable] [ram | rom | nvram]
```

where code refers to executable code, data refers to constant data, and variable refers to read/write program variables. Correct syntactic usage selects one keyword from each group.

While we're on the subject, we will need #pragmas to specify numerous other items, including controller family, specific device, quantities of available memory, initial positions of stack and heap, clock speed, memory model, default math precision (8, 16, or 32 bits), and likely more. Table 1 lists all currently defined #pragmas.

I/O Ports

Most microcontrollers have I/O ports, which may be attached to either internal or external peripherals, such as A/D converters, timers, pulse-width modulation outputs, and so forth. Can we model all those peripherals? No—at least not yet. But we can model the ports, and provide

(continued on page 20)

Q & A

continued from page 5

parts and manuals are now distributed by Orion, 3471 N. Union Dr., Olney, IL 62450; Tel: 800-289-0980; but they don't cover stereos. Some Sansui manuals are available from A. G. Tannenbaum (P.O. Box 386, Ambler, PA 19002; Tel: 215-540-8055; Web: www.agtannenbaum.com). He lists the manual you want for \$17, and we have forwarded your letter to him.

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication) and give your full name and address (we'll only print your initials). *If you are asking about a circuit, please include a complete diagram.* Write to Q&A, **Electronics Now Magazine**, 500 Bi-County Blvd., Farmingdale, NY 11735. Due to the volume of mail, we regret that we cannot give personal replies. **EN**

POPTRONIX®

Online Edition

We're on the web

FREE

**We are starting up,
but you can watch us grow!**

**Projects for beginners
to experts!
New Product information!
Bookstore—discover
what's new!**

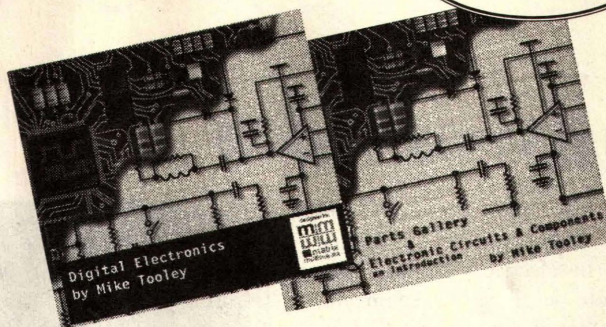
<http://www.poptronix.com>

**WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!**

ELECTRONICS CD ROMs

*The most effective way of
learning Digital Electronics*

*Complete Course
on CD ROM!
Only \$74.99*



Digital Electronics builds on the knowledge of logic gates covered in Electronic Circuits and Components, and takes users through the subject of digital electronics up to the operation and architecture of microprocessors. The included virtual laboratories allow users to operate many circuits on screen.

Digital Fundamentals

Starting from the very basic principles of logic gate operation, Digital Electronics guides users through Boolean algebra, combinational and sequential logic to complex digital systems such as A/Ds and DACs, memories and microprocessors. Virtual Laboratories and worked examples help to build students' confidence and promote understanding.

Combinational Sequential Logic

Multiple gate circuits, equivalent logic functions, and specialised logic functions such as majority vote, parity checker, scrambler, half and full adders. Includes fully interactive virtual Laboratories for all circuits.

Sequential Logic, Digital Systems, and a Gallery of commonly used IC schematics are also included!

- Virtual Laboratories
- Worked Examples
- Full Audio Commentary

See and Test a demo version at <http://www.MatrixMultimedia.co.uk>

Claggk Inc., PO Box 4099
Farmingdale, NY 11735-0792
e-mail: claggk@poptronix.com



Name _____ Phone _____

Address _____

City _____ State _____ Zip _____

Enclosed is \$74.99 for each student version of *Digital Electronics* on a single CD ROM, shipping included inside the U.S. Shipping costs to Canada an additional \$3.00. Overseas orders please contact CLAGGK, Inc. for shipping costs. I am ordering (...) copies at \$74.99 each. NY State residents must include sales tax.

☐ I have enclosed my check for \$ _____

☐ Please charge my credit card for \$ _____

☐ Visa ☐ MasterCard ☐ Discover Expiration Date ____/____

Card Number _____ Signature _____

(Name on order and signature must be the same as on Credit Card.)

Prototype

These Batteries Are Included

While small batteries, called microbatteries, are not new in electrical engineering, a new version, developed by engineers at Brigham Young University (BYU), is unprecedented in size and power—they are as thin as a human hair, yet 100 times more powerful than any existing miniature battery.

This advance could open the door for many others. For example, by incorporating microbatteries directly into the tiny appliances and sensors they build, designers could greatly simplify circuitry in complex systems.

The BYU batteries can also be engineered to be self-recharging using solar cells or by exposing them to radio-frequency energy. That ability could enable a variety of invaluable medical instruments, ranging from the design of rechargeable heart pacemakers that eliminate battery-replacing surgeries to sensors used to regulate the flow of insulin in diabetic patients or to monitor the vital signs of trauma victims. Commercial uses range from self-powered "smart" cards to tiny transmitters on box labels for computerized inventory control.

Medical Applications

"I'm personally convinced that microbatteries have tremendous potential for a large number of autonomous sensor applications, including those in the medical field," says lead researcher Linton Salmon, BYU associate dean of engineering and technology.

Such miniature devices are called micro-electromechanical systems, or MEMS. Over the past twenty years MEMS mechanical systems no larger than a dot have been fabricated for use as pressure sensors, accelerometers, chemical sensors, digital optical components, micromotors, and linear resonators.

Although many MEMS applications



RESEARCHER LINTON SALMON is shown here with a wafer containing 1200 microbatteries.

are still in the developmental stage, the technology is emerging with explosive growth. MEMS design and manufacturing has the potential of a greater than \$8-billion market share by the year 2000, and partially accounts for projections of 10 to 20 percent annual growth in the integrated circuit industry, according to a recent issue of *Aerospace America*.

Although the fabrication techniques for these micro-devices are based primarily on silicon IC processes, many MEMS products have the same problem: they are powered by inconvenient, bulky batteries, or are connected to a remote power source by wires, defeating the purpose of a miniature instrument. Because of a divergence in research interest, reductions in the size of batteries have not followed the miniaturization of electronic devices. This BYU research

has the potential to bring this anomaly into balance.

"If you need to implant a sensor into a person's body, you don't want wires dangling out of the body," says Salmon. "Microbatteries are the answer. They remove the need for connecting wires to power sources or to central control stations. Connections can now be made without wires, similar to radio frequency signals used in cellular phones."

The seed for the research germinated a few years ago while Salmon was employed by the United States government. "When I was supervising MEMS research for the National Science Foundation in the early 1990s, I noticed that fellow engineers were developing tiny, intricate systems that could be very useful except for one problem," says Salmon. "Many of these miniature sys-

tems were powered by a D-cell battery. There's no point in building a MEMS product if there is no energy source correspondingly small enough to power it."

When Salmon returned to BYU, he and his colleagues, including John Harb, associate professor of chemical engineering, embarked on research to see if they could fill that niche.

"The microbatteries we have fabricated to date have energy densities of $250\text{mC}/\text{cm}^2$ with a maximum power output of approximately $20\text{mW}/\text{cm}^2$," Salmon says. "We measure the energy and power densities in terms of area instead of mass because our microbatteries are so thin—less than 100 microns."

Building a Microbattery

In order to build so small a battery capable of these power improvements, the BYU team had to revolutionize the battery-manufacturing process. Previously, microbatteries were assembled piece-by-piece. "We build batteries using the same processes employed to build computer chips—intricate patterning with extremely small dimensions and extremely pure materials," says Salmon. "We hope to achieve the same kind of performance advances in the micropower field that have occurred in the computer industry."

A single microbattery measures one-tenth of a millimeter. The researchers expect most applications to use the batteries in series or parallel configurations. Even so, they are still small enough to package on microchips, ceramics, and plastics.

What's Next?

The BYU team plans to commercialize the technology through Bipolar Technologies, an Orem, Utah company that has applied for patents on the microbattery. Lengthy Food and Drug Administration approval processes for any new medical device probably means the microbatteries will emerge first in non-medical applications.

"Initially we plan to target markets that can use remote or autonomous sensors, such as the automotive industry," says Bipolar founder Rodney LaFollette. "Vehicles now have and will continue to have an increasing number of sensors to monitor conditions like tire wear and engine wear—sensors to map the entire state of the vehicle."—by Douglas Page **PT**

R2-D2 and C3PO— 21st Century Surgeons?

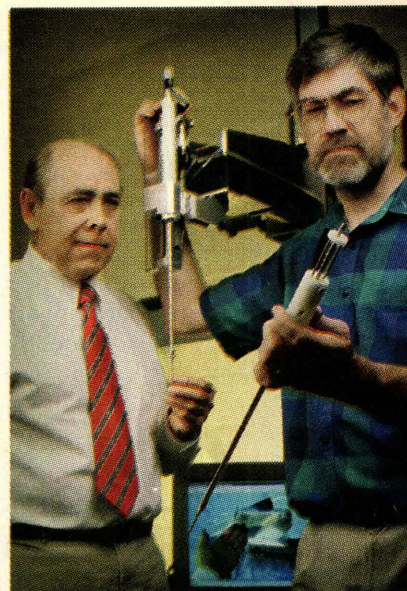
Picture the operating room of the future: Before the first incision, the surgeon uses a customized computer-generated model to make a diagnosis, evaluate treatment options, and rehearse a personalized surgical plan. As surgery starts, a computer displays the surgical plan overlaid on the patient. Robotic devices augment the surgeon's eye-hand coordination during the procedure.

Recently, the National Science Foundation (NSF) began a \$12.9-million, five-year cooperative agreement with Johns Hopkins University to establish an Engineering Research Center (ERC) in Computer-Integrated Surgical Systems and Technology at the Baltimore campuses. This will be the nation's first research center to create computer-linked surgical systems and medical robots. Combining information technology and surgical expertise could dramatically change medical care.

Russell H. Taylor, a computer scientist at the university, will be the director of the center. James H. Anderson, a professor of radiology at the Johns Hopkins School of Medicine, will serve as deputy director. Takeo Kanade, director of Carnegie Mellon University's robotics institute, and Eric L. Grimson, a professor in the Electrical Engineering and Computer Science Dept. at MIT, will be associate directors.

In addition to those already mentioned, other research participants are the Hopkins' Applied Physics Laboratory, Brigham and Women's Hospital, and Shadyside Hospital. Over the first five years, the universities and hospitals involved will contribute another \$8.1 million. Almost \$9 million—including \$1.75 million for the first year alone—is anticipated from industry donors. NSF funding is renewable for an additional five years. The program is expected to be financially self-sustainable after ten years.

Participants and consultants will include experts in computers, engineering, and physicians specializing in radiology, neurosurgery, urology, orthopedics, and ophthalmology. The Carnegie Mellon



RUSSELL H. TAYLOR (RIGHT) OF JOHNS HOPKINS UNIVERSITY, director of the ERC, and James H. Anderson, a professor of radiology at the Johns Hopkins School of Medicine, are seen here working with robotic equipment, including a needle injector. (Photo by Keith Weller)

team will focus on computer vision, sensors, and robotic devices for computer-assisted surgery. MIT will contribute computer models to plan and guide the surgery.

Engineering Research Centers focus interdisciplinary teams of faculty and students on research to produce next-generation technology and education. Through close collaboration with industry and other practitioners, they speed technology transfer. Dr. Lynne Preston, ERC program leader of the NSF, states, "This ERC is an excellent example of how a team of researchers, medical practitioners, and their industrial partners, need a center to achieve their ambitious goals. Their vision of combining capability in robotics, computer modeling and imaging, and human-computer interfaces with surgery is nearly impossible in the traditional, disciplinary construct of a university. The center format enables collaboration across these disciplinary perspectives and sets ambitious technological goals in partnership with both industry and surgeons. Our review panels found this ERC to be very exciting and were optimistic about its potential to have a positive impact on health care." **PT**

Robot Contest

The Trinity College Fire-Fighting Home Robot Contest will be held on the college campus in Hartford, CT on Sunday, April 18, 1999. Open to entrants of any age, ability, or experience, this is the largest, public, true robotic competition of its kind held in the U.S.

Last April, people came from all over the U.S. (all 50 states), Canada, South America, and Europe (14 countries) to compete, participate, watch, and learn—from as far away as Switzerland and Argentina. Participants ranged from college professors and engineers to elementary-school students.

The goal of the 1999 contest is the same—to build a robot that can find and extinguish a fire in a house. The challenge is to build a computerized (not radio-controlled) robotic device that can move through a model of a single floor of a house, detect fire (a lit candle), and then extinguish it. Robots that accomplish the task in the shortest time win.

The 1999 rules are very much like last year's rules, with some slight changes. This international event will culminate months of work and effort by robotists of all ages. There will be two divisions again this year: a Junior division for High School students and younger, and a Senior division for everyone else. A cash prize of \$1000 will be awarded to the winner in each division, with additional prizes to other winners. Other events scheduled on the contest weekend include robotics seminars and expositions.

Trinity College is also helping to set up regional contests around North America. Check the contest's Web page (www.trincoll.edu/~robot) to see if there

is a site near you. Video tapes of the 1998 contest are available for \$25 each (including shipping). Copies of the updated 1999 rules are available for \$3. Send check or money order, payable to Trinity College, to Jake Mendelssohn, 190 Mohegan Drive, W. Hartford, CT 06117, or download the information from the Contest Web page listed above. **PT**

Unbreakable Code?

Scientists at the Department of Energy's Los Alamos National Laboratory have achieved a breakthrough in transmitting secure communications to and from satellites. Based on randomly generated characteristics of individual photons, the encryption scheme could keep financial transactions or military communications safe from hackers and could reveal when there are eavesdropping attempts.

For years, Los Alamos researchers have been transmitting photon-based "quantum cryptographic keys" for encoding messages over optical fibers. However, their latest achievement published in *Physical Review Letters* (PRL), was to transmit a quantum key through the air over a distance of about 1 km.

"This is an important result for our quantum key distribution system," said lead author William Butler, "because it's the lowest few kilometers of the atmosphere that will cause an optical beam to deviate the most. We've shown we can operate this system in the lowest portion of the atmospheric boundary layer, where turbulence is at its worst." If the optical signal emerges mostly intact after passing through the boundary layer, the rest of the travel to a satellite orbiting 300 km or so overhead will have a negligible effect on the signal.

The PRL paper (co-authored by Richard Hughes, Paul Kwiat, Steve Lamoreaux, George Morgan, Glen Peterson, Chuck Gabe, and Beth Nordholt) describes nighttime transmission and detection of the individual photons used to build the quantum cryptographic key. The researchers are now conducting their demonstration in daylight, immensely more difficult, but initial results have been positive.

Existing encryption schemes to protect financial transactions, national-security information, and other significant

communications suffer two weaknesses: the numerical-based keys are potentially vulnerable, and they can be intercepted. Quantum cryptographic keys, by contrast, are generated as needed between the sender and receiver, creating a random string of numbers known only by them. Any attempts to intercept the shared communication or eavesdrop can be detected because of the message's quantum-based nature.

Once the sender and the receiver share a unique key, they can code, transmit, and decode messages securely.

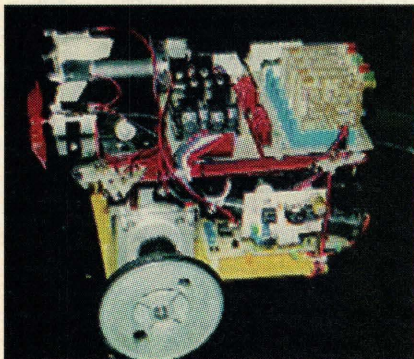
The Los Alamos demonstration consists of a laser that can emit extremely short pulses; an attenuator that damps each pulse to a single photon, on average; and a system that randomly assigns one of two polarization states to the photon. The two polarization states represent "1" and "0" in a binary number sequence. Polarization describes a preferred direction of oscillation for the electromagnetic wave of a photon. Devices known as polarizers will transmit only specific polarization states.

The receiver includes a telescope and optics that randomly direct the photons collected along one of two paths, each configured to look for a specific polarization state.

The quantum key is generated when the sender, conventionally dubbed "Alice," generates a series of individual photons, shot out at a rate of a million per second, and randomly changes the polarization to create a sequence of zeroes and ones. She has told the recipient, dubbed "Bob," which polarization state represents a one and which a zero; this information can be shared with the world at large without threatening the encryption scheme.

Bob captures as many of the incoming photons as possible, given the difficulty of plucking specific individual photons out of a sea of background photons. The Los Alamos group has shown that with precision timing and properly chosen filters a sufficiently high number of photons can be detected to make the quantum encryption scheme work.

Bob's receiver randomly switches between his chosen polarization values for zero and one. He doesn't, however, try to measure Alice's original polarization states; instead, he looks for related polarization states. This ensures that when Bob



ONE OF THE "CONTESTANTS" from the 1998 Trinity College Home Robot Contest. (Photo by Jose Ordinas)

is looking for a zero, he will never see a photon if Alice transmitted a one. Yet, a fraction of the time that he is looking for a zero and Alice transmits a zero, he will record a photon and know their two values were in agreement.

In less than a second, Alice can transmit a sequence of many thousands of photons. Bob will detect and agree with the value of some random fraction of these, about a quarter of the original photon stream on average. Bob then indicates the positions in the sequence where his value agreed with Alice's. This positional information, in which only Bob and Alice know the values for each point in agreement, allows them to form their secret quantum key. If anyone intercepts the photon stream, the act will reveal itself by raising the error rate above a threshold value or eliminating the photon stream altogether.

The researchers say the quantum key distribution system could provide secure uplink and downlink satellite communications, and connect cities anywhere in the world via satellite.

PT

Quantum Computer Calculations

Scientists have manipulated the atomic spin of molecules to demonstrate that reliable calculations can be made by a quantum computer. A report was published in a recent issue of *Physical Review Letters* (PRL) on the first experimental use of quantum error correction and on a demonstration of a three-bit quantum computing system.

Working with David Cory at MIT, Los Alamos National Laboratory physicists Raymond Laflamme, Wojciech Zurek, and Emanuel Knill are using nuclear magnetic resonance (NMR) to test their theories. "We have demonstrated for the first time that our quantum error correction works as expected. It is also the first time anyone has manipulated three bits in a quantum mechanical way," said Laflamme. "This is the most interesting proof to date that quantum computing is not just a crazy idea."

Unlike today's "classical" computers that make calculations with a binary system of zeroes and ones from digital switches, first-generation quantum com-



USING THE SETUP SHOWN HERE, Los Alamos researchers have successfully transmitted a quantum key through the air over a distance of about 1 km. That achievement could lead to ways to transmit sensitive data using a virtually unbreakable encryption code.

puters are assembled from molecular switches called qubits. A qubit can represent one, zero, or potentially any state in between. A functional quantum computer will manipulate atoms to perform many calculations at once by taking advantage of quantum mechanics, which allows qubits to represent many states simultaneously.

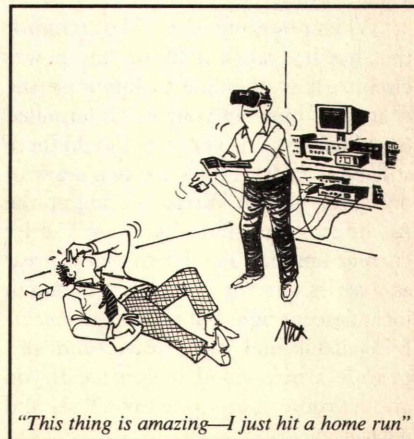
"Suddenly you have information encoded on single atoms, and you can do things that you never thought you would be able to do before," said Laflamme. Until recently, the main problem for quantum computing was believed to be an inability to correct errors. Two years ago, the Los Alamos team developed a scheme that uses repetitive processing to reduce the probability of errors. For the general error type, every encoded qubit is checked for errors, corrected, then multiplied five times. Those five qubits also get checked for errors, then corrected and multiplied, etc. Knowing how many steps a particular calculation takes, the theorists can determine the number of checks needed to ensure the calculation's accuracy.

Now the physicists have adopted NMR techniques for experimenting with qubits. NMR allows scientists to manip-

ulate the atomic spins of nuclei by applying an electromagnetic pulse to molecules diluted in a liquid. The signal is amplified by the molecules acting in parallel. Because the researchers knew the most common errors in NMR were of a specific type, they could test quantum error correction ideas using only a three-qubit system.

Functional quantum computers that exceed current machines are years away. However, these experiments show the hurdles to overcome are merely mechanical—the difficulty of manipulating individual atoms.

PT



Monitor Power-Supply Problems

THIS MONTH WE'LL BEGIN OUR DISCUSSION OF ACTUAL MONITOR FAILURES BY DEALING WITH PROBLEMS WITH THE LOW-VOLTAGE POWER SUPPLY. UNFORTUNATELY, THERE ARE SO MANY VARIATIONS IN MONITOR DESIGNS AND POTENTIAL

problems that this series can touch on only a small fraction of the possibilities. However, the most common ones are still going to be shorted/blown parts and bad connections.

With a half-dozen or more separate voltages required by the typical SVGA monitor, a dead monitor is only one of the possible symptoms of a low-voltage power-supply problem. If one of these voltages is missing or incorrect, a number of systems can be affected—and in unexpected ways.

The Series Light Bulb Trick

Before we get into the gory details of monitor troubleshooting, here is possibly the single most-useful and inexpensive gadget you can use when servicing power electronics. This is one of several of my "Incredibly Handy Widgets(tm)!"

When powering up a TV or monitor that has had work done on any power circuits, it is desirable to minimize the chance of blowing your newly installed (and likely expensive) parts should there still be a fault. There are two ways of doing this—use a Variac to bring up the AC line voltage gradually or use a series current limiter. One device that is great as a series current limiter is a common incandescent light bulb—they are readily available and inexpensive, and also provide a nice visual indication. If you go that route, here is what you'll see and what it means:

- Full brightness: a short circuit or extremely heavy load—a fault probably is still present.

- Initially bright, then fading to a reduced brightness: this is what is expected if operation is normal—the brightness drops as the filter capacitors charge.

- Pulsating: the power supply is trying to come up but shutting down due to an overcurrent or overvoltage condition. It is also possible that the wattage of the light bulb may be too low for the equipment.

Note: for a TV or monitor, unplug the internal degauss coil as it represents a heavy initial load that could prevent the unit from starting up with the light bulb in the circuit.

The following are suggested starting wattages for the bulbs: 40 watts for a VCR or laptop-computer switching power supplies; 100 watts for small (*i.e.*, B/W or 13-inch color) monitors or TVs; and 150 to 200 watts for large color monitors or projection TVs. You may need to go to a higher wattage with some equipment, but don't be tempted to remove it entirely until you are absolutely sure that the fault is no longer present.

Unfortunately, some monitors simply will not power up at all with any useful-sized series load (in terms of wattage). The microcontroller apparently senses the drop in voltage and shuts down. However, these seem to be the exceptions.

Power-Supply Fundamentals

Monitors require a variety of voltages

(at various power levels) to function. The function of the low-voltage power supply is to take the AC line input of either 115 VAC, 60 Hz (220 to 240 VAC, 50 Hz or other AC power in Europe and elsewhere) and produce some or all of those DC voltages.

- In all cases, the B+ (B+ refers to the main DC voltage that powers the horizontal deflection system of most monitors) to the horizontal output transistor or (HOT) is obtained directly from the low-voltage power supply.

- With small video monitors that operate at a fixed scan rate (*e.g.*, TV monitors), many or most of the low voltages may be derived from secondary windings on the flyback (LOPT) transformer.

- The typical SVGA autoscanner will use one or more switchmode power supplies (SMPSs) to provide most or all of the low voltages—the flyback isn't used for this purpose.

- There are also various (and sometimes convoluted) designs using combinations of any or all of the above.

Figure 1 shows the complete schematic for the switchmode power supply (SMPS) from a small "I guarantee you never heard of the brand name" SVGA color monitor. The AC line-input and degauss components are at the upper left; the SMPS chopper, its controller, and feedback optoisolator are in the lower left/middle; and the secondaries—some with additional regulation components—occupy the entire right side of the diagram. Even for relatively basic application such as this, the circuitry is quite complex. There are more than a half-dozen separate outputs regulated in at least three different ways!

For large high-performance autoscanner monitors, it becomes even worse as highly-stable voltages need to be pro-

grammed based on a wide range of scan rates. Several common design approaches are used to generate the required variable regulated B+ voltage:

1. A separate programmable SMPS generates the B+. This is done by selecting its reference voltage or the fraction of the output voltage that is fed back to the regulator.

2. A voltage from the main SMPS is fed through an additional series switch-mode or linear regulator that drops it down to the required value.

3. One of several fixed post-regulators is selected based on scan rate.

Technique 2 is used by the power supply in Figure 1. The circuitry is located in the upper right-hand corner of the schematic.

Power-Supply Components

All monitor low-voltage power supplies will have:

1. A power switch, relay, or triac to enable main power.

2. Various line-filter, RFI, and surge-suppression components (coupled inductors, LCL filter networks, MOVs, etc.).

3. A set of rectifiers—usually in a bridge or doubler configuration—to turn the AC into DC.

4. One or more large filter capacitors to smoothe the unregulated DC (usually 150 to 160 or 300 to 320 VDC depending on design).

5. A discrete, hybrid, IC, or switch-mode regulator to provide B+ to the horizontal deflection.

6. Some means of generating the various other DC voltages required by the monitor's analog and logic circuitry.

7. Zero or more voltage dividers and/or regulators to produce additional voltages directly from the line power.

8. A degauss-control circuit. Monitors having manual degauss buttons will include additional circuitry.

9. A startup circuit for booting the horizontal deflection if various voltages to run the monitor are derived from the flyback. This may run off a non-isolated voltage or the standby power supply, or it may be derived from the video input (mostly small video monitors, not auto-scan types). However, the SMPS itself will have a startup circuit!

10. A standby power supply if the monitor doesn't use a latching power switch.

Items 1 to 6 might be part of a separate low-voltage power supply module or located on the main board.

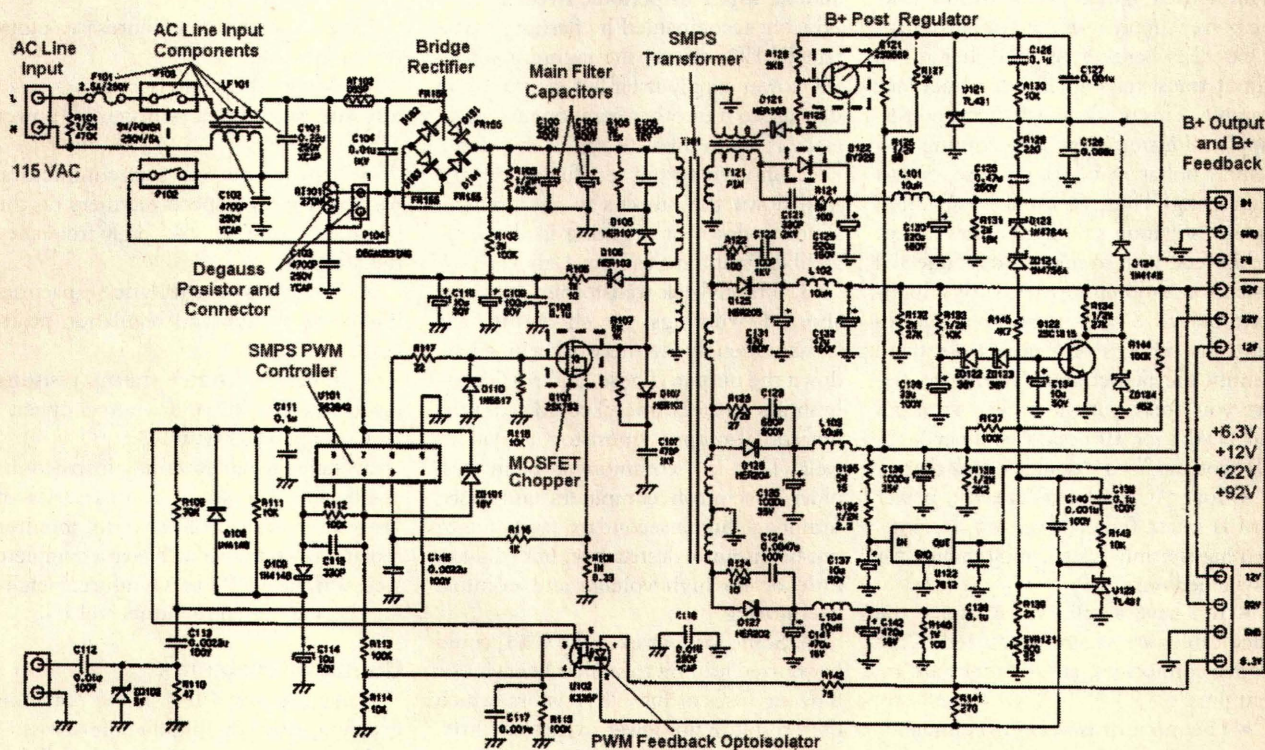
Power-Supply Symptoms

Low-voltage power-supply problems can manifest themselves in an almost unlimited number of possibilities, but the following probably cover the most likely:

- Monitor is as dead as a concrete block—no picture or raster, no LEDs lit, no sounds of life (like degauss) of any kind. Most likely causes: No power at AC outlet or outlet strip, bad or loose line cord, bad power switch, blown fuse due to internal short or overload.

- No picture but unusual sounds like a whine, periodic clicks, tweets, or flubs, and/or possibly flickering or flashing front-panel LEDs. Most likely causes: Excessive load or short on output of power supply (shutdown or cycling due to overcurrent) or loss of horizontal drive (cycling from overvoltage due to lack of load).

- Unusual aromas, smoke, or six-foot flames coming from inside the case. Most likely causes: Failed parts in low-voltage power-supply, deflection, or high-voltage sections. Actually, while burning smells and even smoke aren't that unusual when parts overheat as a result of a short circuit, actual fire is quite unlikely due to regulatory design requirements for mate-



Typical Switchmode Power Supply for Small SVGA Color Monitor

FIG. 1—HERE'S THE SCHEMATIC of a typical switchmode power supply found in small SVGA computer monitors.

rials and protection devices UNLESS safety systems have been tampered with or the monitor has been operated in an environment where there is lots of flammable dust.

- Jittering, vibrating, or unstable picture. Most likely causes: External magnetic interference or power-line noise, hum in various power-supply voltages resulting from dried-up main-filter capacitor(s) or other capacitors, resistors out of tolerance—all affecting power supply regulation.

- Loss of video, deflection, geometry or size problems, or some or all adjustments have no effect. Most likely causes: Failure of one or more power-supply voltages, selection circuitry not selecting properly (autoscan monitors), bad connections.

- Monitor doesn't power up immediately. Most likely causes: Dried up electrolytic capacitors in power supply or bad connections.

- Interaction of adjustments (for example, turning up the brightness results in a loss of sync or a wavy raster). Most likely causes: Poor power-supply regulation due to bad capacitor, resistor, regulator, or other component, or bad connections.

Note that the underlying cause of any of the above might not be in the low-voltage power supply itself, but might actually be elsewhere—a shorted horizontal output transistor or deflection yoke, for example. This results in either the power-supply shutting down, becoming extremely unhappy, blowing a fuse, or just plain dying. Thus, we cannot really limit our investigation to only the power supply! In fact, with so many interconnected systems in a monitor, particularly a high-performance SVGA model—it can require the services of a master sleuth to identify the perpetrator! Therefore, before you break out the socket wrenches and DMM (or 10 pound hammer!)—or call Scotland Yard—double check that:

- Your AC outlet is live, the power cord is intact (not chewed by the dog), the plug is firmly seated, and the monitor is switched on.

- You have a valid video signal, the video cables are securely attached to the proper connectors, and/or there are no bent pins.

- The monitor isn't being commanded to go into a power-savings mode because your computer thinks it is smarter than you!

- You have the front-panel switches and controls set properly and the

video-source selection is correct. Reset it to factory defaults.

If possible, try the monitor with another known-good video input that is compatible with its scan rates and signal levels, or substitute a known-good monitor for the suspect unit. In other words, try to rule out external problems and “cockpit error.”

Monitor Power-Supply Problems

WARNING: You should always use an isolation transformer when working on a monitor, but this is especially important—for your safety—when dealing with the non-isolated line-operated power-supply section. Read and follow the safety guidelines presented last month and at my Web site. If there is anything you are unsure of, or if you are not familiar with the hazards and procedures required when dealing with potentially lethal voltages, stay out and get a professional's help!

The following can cause symptoms of a dead or mostly dead monitor:

1. Shorted horizontal-output transistor (HOT). This will usually blow a fuse or fusable resistor as well if fed directly from the AC line. However, when fed by a SMPS, the result may just be a soft audible whine or periodic tweet or flub, possibly accompanied by flashing front-panel LEDs. Here, the failure is not in the power supply itself but may result in damage to it or other components, especially if it continues to run in this state.

2. Shorted output rectifier diodes can load down the outputs to the point of shutting down or resulting in the same audible symptoms as item 1 above.

3. The flyback transformer can have shorted windings or shorts in the focus/screen divider network which load down the output. Those (and particularly shorts in the primary) could cause the horizontal-output transistor to fail as well. That is a common problem with older Macintosh computers and video terminals. Some secondary faults might not be instantly destructive, but result in little or no high voltage and eventual overheating.

4. Some load, or even the CRT, could be shorted leading to similar behavior or blowing fuses or fusable resistors, which then result in no power to that circuitry.

5. A failure in horizontal-drive chain; that includes the horizontal oscillator, driver, or driver transformer. Without drive, there will be no deflection and that will either result in no high voltage

directly (when it is derived from the horizontal deflection) or cause it to be shut down to prevent CRT screen burn (from a stationary spot or line). When powered by an SMPS, there may be an audible ticking from the SMPS cycling on over-voltage due to lack of a load.

6. Failure of an SMPS to start. There can be any number of causes, though dried-up electrolytic capacitors and open high-value startup resistors are high on the list if the chopper transistor is not blown.

7. Cold solder joints or other bad connections; monitors tend to have these as a result of temperature cycling and—with all too many—poor manufacturing-quality control. It is possible that no parts have been damaged—at least not yet. Resoldering may be all that is needed.

Troubleshooting The Switchmode Power Supply

If the SMPS is a separate module, it may be possible to unplug its output connector and test it for proper operation independently of the monitor circuitry. However, a minimum load might be needed—at least on the output that is used for regulation feedback—and there could be other interlocks that will complicate your testing.

The most common failures in a monitor SMPS are:

- Main chopper transistor; in a monitor, this is often an expensive power MOSFET.

- Other shorted semiconductors, particularly high-speed rectifiers on the secondary side of the high-frequency transformer.

- Dried-up electrolytic capacitors leading to startup and regulation problems.

- Open high-value startup resistors resulting in no initial drive to chopper.

- Bad connections.

Detailed troubleshooting instructions are beyond the scope of this series of “Service Clinic” columns on monitor repair. However, we will have a complete series on the SMPS in the future, including those found in monitors and PCs.

Common Problems

Here are just a few of the common problems that you might come across:

Power button on monitor is flaky:

If the on/off (or other button) on the monitor itself behaves erratically, then the most likely cause is the obvious—the button or switch is dirty or worn.

Believe it or not, that isn't as unusual as you might think. On a momentary push-button, if you can get at it, some contact cleaner could help. Replacement with a common pushbutton or toggle-type switch (as appropriate) might be much easier than attempting to locate the original part!

Dead monitor: That means there is absolutely no evidence of anything happening when the power switch is activated. The most likely causes are:

- Outlet isn't live, or the power cord is loose or defective. Try something else in the outlet, and inspect/replace the power cord.

- Bad power switch. With plug pulled, check for continuity in the on or pressed position.

- Blown fuse or fusible resistor (probably from shorted parts in power supply or elsewhere like the HOT).

- Bad power supply (not starting up or just dead), bad connections. However, degauss would likely still operate in this case.

Monitor blows fuse: If the fuse really blows absolutely instantly with no indication that the circuits are functioning (e.g., no static on the screen), then this points to a dead short somewhere quite near the AC power input. The most common places would be:

- Degauss Posistor.
- Shorted parts in the AC-input line-filter capacitors and MOVs.
- Diode(s) in main bridge.
- Main filter capacitor(s).
- SMPS chopper (usually a MOSFET) if there is a line-operated SMPS or HOT (if there is a deflection derived power supply).

You should be able to eliminate those one by one using a multimeter to check for short circuits/low resistance. For everything but the HOT or chopper, replacing the bad parts should be all that is needed—those rarely fail due to OTHER parts going bad.

However, if the HOT or chopper tests bad, it is possible (though not always the case) that something downstream is causing an excessive load that caused the part to fail. Therefore, don't put the cover back on just yet!

Instead, install a new transistor and power the monitor using your series light bulb. If the bulb flashes once and then settles down to a low brightness level, the monitor might be fine. Even a pulsating light bulb might just mean that the light bulb is too small for the monitor power

requirements. It might be safe to try a higher wattage bulb.

However, if the bulb glows at close to full brightness, there is probably still some fault elsewhere. Don't be tempted to remove the light bulb just yet. There is still something wrong. Continue to search for shorted parts.

Fuse replaced (doesn't blow) but monitor is still nearly dead: There might be a click indicating that the power relay is engaging (there could be bad contacts, though this isn't that likely) and the degauss is probably working now. Since the fuse doesn't blow now (you did replace it with one of the same ratings, right?), you need to check for:

- Other blown fuses. Occasionally there is more than one in a monitor.

- Open fusible resistors. Those are usually low values (a few ohms or less) and are in big rectangular ceramic power-resistor cases or smaller blue or gray-colored cylindrical power resistors. They are supposed to protect expensive parts like the HOT, but often blow at the same time, or the expensive HOT or SMPS chopper sacrifices itself to save the 25-cent resistor. Anyway, if any of these test open, they will need to be replaced with flameproof resistors of the same ratings. However, you can substitute an ordinary resistor for testing purposes ONLY as long as you don't leave the monitor unattended.

If you find one bad part, still check everything else, as more than one part may fail; and just replacing one might cause it to fail again. There may also be bad connections that are the cause of the original failure. So, always inspect for those.

Power-on "tick-tick-tick" or "click-click-click" but no other action: A variety of problems can result in this or similar behavior. Possibilities include:

- Lack of horizontal drive. The main regulator is cycling on overvoltage due to very little load.

- Excessive load or faulty power-supply cycling on its overcurrent protection circuit. The sound in this case may be more like a "tweet-tweet-tweet" or "flub-flub-flub," however—see below.

- HV shutdown, or some other system detecting an out-of-regulation condition. However, in this case, there should be some indication (like a momentary high-pitched deflection whine, static on the screen, etc.) that the deflection and HV is attempting to come up.

- A dried-up main filter capacitor or

other filter capacitor in the low-voltage power supply that is producing an out-of-regulation condition.

- A problem with the microcontroller, relay or its driver, or standby power supply.

Dead monitor with audible whine, periodic tweet or flub, and low-low voltage: A monitor that appears to be dead except for an audible whine or a once-a-second or so tweet or flub coming from the SMPS usually indicates an overload fault in the power supply itself or a short in one of its load circuits. The power (or other) LED may be weak or flashing as well. Here is a summary of the possible causes:

- Shorted rectifiers or capacitors on secondary side of SMPS.

- Other problems in the power supply or its controller, like bad capacitors.

- Shorted HOT.

- Flyback with shorted turns or a breakdown in the focus/screen divider network.

- A short or excessive load on the secondary supplies fed from the flyback.

- Short in horizontal yoke windings.

- Bad solder connections.

Note that a whine may be perfectly normal for your monitor if there is no video input—confirm that there is a signal that is compatible with the monitor's scan rate(s) and type of sync (e.g., separate, composite, or sync-on-green). Assuming you know that the input is valid, that may indicate an overloaded low-voltage switching power supply. The whine is caused by the switching power supply's chopper frequency dropping down due to the overload. The periodic tweet or flub is caused by the SMPS attempting to come up, sensing the excessive load, and restarting.

Test the B+ input to the flyback. If it is near zero, test the HOT for shorts and replace but continue testing with a series light bulb and/or Variac. There may be something causing the HOT to go bad, like a shorted flyback or bad damper diode or snubber capacitor.

If the voltage is not zero but is low (e.g., it should be 120 volts but is only 60 volts) or fluctuating in time with the tweet or flub, there may be a problem with the SMPS itself, the flyback, the deflection yoke, an excessive load somewhere else, or improper drive to the HOT.

Reduced width picture and/or hum bars in picture: The most likely cause is a dried-up main filter capacitor. Once the effective capacitance drops low enough,

120-Hz (or 100-Hz in countries with 50-Hz power) ripple will make its way into the regulated DC supply (assuming full-wave rectification).

Another likely cause of similar symptoms is a defective low-voltage regulator allowing excessive ripple. The regulator IC could be bad or the filter capacitor following the IC could be dried up.

Wiggling or jiggling picture: Depending on the frequency of the instability relative to the scan rate in use, the symptoms might be that the entire picture is vibrating, that ripples are moving up or down the screen, or something else. There may also be variations in brightness—hum bars—in the picture.

First, eliminate the possibility of external magnetic interference, power-line noise, or a video-card/computer problem. Try the monitor in another location and on another computer if possible. Or, try another similar monitor in its place.

Once these causes have been ruled out, the most likely ones are:

- Dried-up electrolytic capacitors in the power supply.
- A resistor or other component has changed value in the B+ (or other) regulator. For example, one very common monitor—the Gateway CS1572FS—uses a 91K, 1-watt resistor (R331) to set its 180-volt B+ output. Invariably with use and age, that device's resistance increases in value, leading to a vibrating raster and eventual failure of other parts.

- Bad connections.

Monitor doesn't power up immediately: The monitor might do nothing, cycle on and off for a while, power up and then shut down in an endless cycle—or at least for a while. Then it comes on and operates normally until it is turned off. A couple of possibilities here:

1. The main filter capacitor or other filter capacitors in the low-voltage power supply is dried up, and this can cause all kinds of regulation problems. Other regulating components might be marginal. That might be allowing excessive voltage to reach the output of the power supply, and then the X-ray protection circuitry shuts things down.

2. Bad connections might be preventing the power supply from operating normally until the main board or components heat up a bit.

Adjustment or picture interactions: This describes problems such as turning up the brightness causes a loss of sync; adjusting height also affects width

or produces a wavy raster; or a bright picture or opening a bright window results in a significant change in picture size, wiggly edges, or in the monitor shutting down!

Those might be caused by poor regulation in one or more low-voltage power supplies or an interaction between the high-voltage and low-voltage power supplies, which in turn could be caused by a dried-up capacitor if the unit is relatively old, bad connections, or another faulty component. Measure the B+ to the horizontal deflection (to the flyback, not the horizontal output transistor). If it is changing with the problem, then a regulation problem is confirmed. If that voltage is solid, you will need to check the others to see which one is actually changing.

Wrap Up

That's it for now. Next month we'll explore the exciting world of deflection system failures! Until then, check out my Web site, www.repairfaq.org. I welcome comments (via e-mail only at sam@stdavids.picker.com, please) of all types and will reply promptly to requests for information. See you next time! **EN**

COMPUTER CONNECTIONS

continued from page 8

language-level support for them. Figure 3 adds ports to the model.

However, there are three operations we need to perform on I/O ports: reading, writing, and configuring. In addition, there are lots of variations in how ports work. For example, various ports provide various types of inputs, including one or more of latched, buffered, sample-and-hold, and direct signal-level. How can we distinguish among them?

I decided not to, even though modeling them was great fun, and allowed me to introduce a C++ like struct or class object, encapsulating both data and methods. I decided not to because the more I thought about it, the more things I thought it would be nice to have. Increasing features increases the raw footprint of what is required to support the base language, hence occupied storage in the target system. It was also taking me far from my goal of minimizing differences between this language and Standard C.

The simplest, and most elegant, is just to make port another type qualifier, with

syntax identical to ram, rom, and nvram. Thus:

```
int port[0] p;
```

declares a port p at I/O address 0, and

```
int port[0x20] p[10];
```

declares an array of 10 ports beginning at address 32 (decimal). Reading from a port is nothing but an assignment statement

```
i = p;  
i = p[0];
```

Likewise, writing to a port is also an assignment statement:

```
p = i;  
p[0x17] = 2;
```

As applied to a port, the address operator (&) would return the address of the port, just as you would expect, e.g.,

```
a = &p;
```

If "p" refers to I/O port 17h, then "a" contains 0x17 after the previous statement executes. It might be nice to allow "p" to be an lvalue, so that you could change the port to which a variable referred to at runtime, like this:

```
&p = 22;
```

Hmm, have to think about that one.

The Grand Finale

Obviously, that's not the end of the story. However we're out of space, and time. While I've had a lot of fun bringing you "Computer Connections" over the last many years, all good things must end eventually, and that time is here. "Computer Connections" will go on, however, just with someone else at the helm.

I'll be going on as well. For those who want to learn more about Portable Embedded C, visit the Ingeniery Web site (www.ingeninc.com). There you will find the first implementation of this language, specifically for the Atmel AVR. It's not Small C (or Tiny C or Godzilla C), but highly ANSI/ISO-compliant Portable Embedded C.

And for those who just want to say hello, or discuss any of the many topics we've covered over the years, you can reach me at jeff@ingeninc.com. **EN**

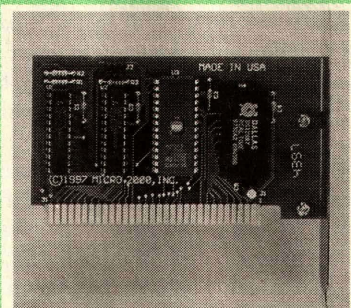


EQUIPMENT REPORT

MICRO 2000 CENTURION YEAR-2000 SOLUTION FOR THE PC

Here's an inexpensive way to protect your PC hardware from a Y2K meltdown

CIRCLE 15 ON FREE INFORMATION CARD



Unless you've been in hibernation, you've likely heard of the "year 2000" or "Y2K" problem. In a nutshell, it is that most software running on main-frame computers was written decades ago, is poorly documented, and suffers from a fatal flaw. That flaw is keeping within certain bit constraints inherent to the software code, dates were recorded using only two digits for the year. Back when most of this software was written, the thought that a lot of this stuff would still be vital, let alone even still in use, was just not conceived of or seriously considered.

Now, however, that oversight is causing governments and corporations major headaches. That is because experts believe that, when faced with a year value of 00, computers will take that to mean 1900, not 2000. If that is correct, all sorts of problems are likely to crop up in the computer systems that run banks, stock exchanges, power systems, the air-traffic control system, etc.

Now, if that nightmare was not enough, here's another one to consider: Did you know that many modern personal computers are vulnerable to the same glitch. That's because, believe it or not, some PC BIOSes are not Y2K-compliant, and neither are some real-time clocks, or RTCs. The BIOS usually checks the RTC for the time during bootup, and if either one has a problem there could be trouble in store for the computer, or more specifically, its owner. Even some flash BIOSes are affected—some have multiple layers, with basic date

information hard-coded into a non-flashable layer.

Here's a typical scenario of what will happen to a non-Y2K-compliant PC when the year 2000 strikes: First the clock reverts to the year 1900. Then the BIOS checks the clock and suspects it to be wrong, so it sets the year back to some date, though probably not the right one. The least of the problems are that file date codes will be set improperly, and the worst of it could be accounting and billing departments gone haywire. Some software will crash, as will entire systems.

Micro 2000 Centurion

Fortunately there is an easy—and free—way to determine if your PC will suffer, and an inexpensive way to fix troubled PCs. Micro 2000, Inc. (1100 East Broadway, Suite 301, Glendale, California 91205; Tel: 800-864-8008; Web: www.micro2000.com) has free software available from its Web site that runs extensive tests on your computer to determine if there are any problems associated with the date. It basically sets and resets the clock numerous times and checks to see if everything remains operational.

If there is a problem, Micro 2000's Centurion, available for only \$59.95, can fix it. The Centurion squeezes in between a computer's BIOS and RTC, and maintains an accurate date with seamless operation. Its on-board clock and internal lithium battery will keep the date and time accurately for up to 30 years, and up to 10 years with no exter-

nal power, so it's always ready to update the system calendar when needed. A replacement BIOS must be matched to a motherboard, but the Centurion, which needs only an 8-bit ISA or EISA bus slot, will work with any IBM-compatible motherboard.

Usually you don't have to configure the Centurion, though sometimes three jumpers must be set for the primary or alternate I/O address and one of four possible ROM addresses. The Centurion automatically assumes that the PC's date is correct when the card is first installed. Afterwards, when the BIOS requests the time, it comes from Centurion's RTC and not the system's. Whenever the BIOS is instructed to change the time, the Centurion's time is updated and both RTCs are synchronized as much as possible. Once installed, operation is transparent to the user.

The Centurion was tested in an old 486 that indicated problems when tested with Micro 2000's free software. Sure enough, the same system passed the Y2K test with Centurion on board. Of course, only the actual turn of the century and extensive user intervention will reveal the real extent of the matter. Old software that might be affected will still have to be updated for Y2K-compliance, but at least your hardware won't be at fault with the Centurion installed.

While the best solution might be to obtain a certified Y2K-compliant machine (less of a hardship than ever thanks to the bargain prices now available on even cutting-edge systems), there are many reasons why that might not be possible. Fortunately, there is a low price alternative that will help keep your older machine viable for as long as you'll need it. At the very least, you owe it to yourself to download Micro 2000's free software before the year is up to see if your PC is affected.

For more information on the Micro 2000 Centurion, contact the manufacturer directly or circle 15 on the Free Information Card.

EN



LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

Lights Out

Technology may have overcome bureaucracy for once. I thought my fellow readers might enjoy this discovery.

I have a fairly private back yard with a hot tub on the deck; and I enjoy relaxing in the tub, especially on a cold winter night, just watching the moon and stars. However, there is a very bright street light on the edge of my property, which illuminates the back yard with the orange glare typical of sodium vapor lamps. I pay the power company \$7 per month to operate this light for security. Since I pay for the light, I thought it would be nice to be able to turn it off occasionally. I called the power company and asked them if they would install a switch on the telephone pole. That was like running into a brick wall! We can't do that; it's against company policy, etc., etc.

I considered installing my own light

switch, but there were some tough obstacles. It was probably illegal to modify their equipment; they might discover the switch; I didn't have a tall ladder; and finally there was a high-voltage power line running close to the light fixture.

One night I was sitting in my hot tub staring at the darn light when a solution hit me. As luck would have it, the photoelectric sensor on top of the light fixture is visible from my back yard. I mounted a 4 mW laser-diode pointer in a ball joint on a stand and simply pointed it at the photo sensor. The street light immediately went out, thinking it was daylight! Now I can turn it off from my deck any time by remote control and haven't modified their equipment. (I don't know the full implications of this discovery, but there are very few street lights in my city that can't be turned off from the right vantage point.)

Keep up the good work with **Electronics Now!** There are still lots of us out here who like to design and build our own electronics.

NAME WITHHELD
Kingsport, TN

generation 28-pin Microchip controller, such as a PIC16C63, to perform essentially the same task with only one chip.

By correctly programming the PWM circuit on the chip, you can get precision pulses as short as 50 ns at a 5 MHz (200 ns) repetition rate all the way up to about 200 μ s at a 1200 Hz (800 μ s) repetition rate. These pulses are generated purely in hardware and need no software intervention, once the CPU registers are set. There are also two separate PWM channels available. If slower pulses are desired, they can be generated in software.

Anyone wanting additional details can e-mail me at: oricom@sni.net
DAN MICHAELS
via e-mail

Current Mirrors

Readers of Skip Campisi's article, "Möbius Circuit" (**Electronics Now**, November 1998), might like to know that they can make very fine NPN current mirrors with the 3046 and 3086 series of five-transistor arrays. These parts, which come in a 14-pin DIP package, make the matching and temperature tracking of individual transistors unnecessary.

They are also handy for making your own fast op-amps. Digi-Key (Tel: 800-344-4539) sells them as their part numbers LM3046N-ND or LM3086N-ND for under \$1.50. Unfortunately, there seems to be no equivalent PNP part, except some that use very slow lateral transistors.

TOM NAPIER

BUY BONDS



MULTIMEDIA on the PC!

What is Multimedia? What can it do for you? It can do lots of nice things! This 184-page book helps you create your own multimedia presentation.

Multimedia applications by people like you can revolutionize educational and business applications as well as bring more FUN, FUN, FUN into your leisure computer activities.

Mail coupon to:

Electronics Technology Today, Inc.
P.O. Box 240
Massapequa Park, NY 11762-0240

Please send me my copy of *Multimedia on the PC* (PCP120). I enclose a check or money order for **\$18.95** to cover the book's cost and shipping-and-handling expenses. NY state resident must add local sales tax.

Name

Address

City State Zip

All orders must be paid in U.S. funds only. Sorry, no orders accepted outside of USA and Canada. Please allow 6-8 weeks for delivery.

MA02

One Chip for Six

In his article, "A Microcontroller-Based Precision Pulse Generator," (**Electronics Now**, December 1998), Tom Napier shows a circuit for a precision pulse generator using six ICs, based upon a PIC16C55 chip. Readers might be interested in knowing that they can use a slightly more expensive second

Write To:

Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Manual Wanted

HELP! I'm in need of the user manual, specifically the schematic page for the Realistic 42-210A Magnetic Phono Preamp. If anyone can help, please mail me a copy. I hope someone out there has one available.

KEN SIMMONS
29101 38th Avenue So.
Auburn, WA 98001

EN



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

Video-Signal Generator

DESIGNED FOR SERVICING high-end computer monitors and performing color alignments from a new PC-based system format, the CM2250-PC "PRO" Computer Monitor Analyzer is a multi-featured "Plug & Play" video-signal generator. Its ease of use and flexibility of operation make it ideal for testing and aligning high-end displays.

The CM2250-PC "PRO" simplifies the setup for troubleshooting monitors. Technicians simply select the make and model of the monitor, and the CM2250-PC "PRO" automatically configures to its setup. The ability to store over 2000 monitor setups is integrated into the CM2250-PC "PRO." Users can access the appropriate setups through either a convenient charting system or by scrolling through the monitors on the screen and pressing <ENTER>. There is no need to refer to service literature nor does the technician have to lose valuable time entering parameters.

Its exclusive "Process Generator" enables testers to use one system to control the testing and alignment process. The CM2250-PC "PRO" will change the video patterns and signal parameters, wait for the user to make a test or adjustment, and then go through the next step—all automatically. Other features of the computer-monitor analyzer are color-output analysis with the CP288 Auto "ColorPro II" and video generation (to 250 MHz) for complete monitor color analysis.

The CM2250-PC "PRO" has a list price of \$6995.

SENCORE, INC.

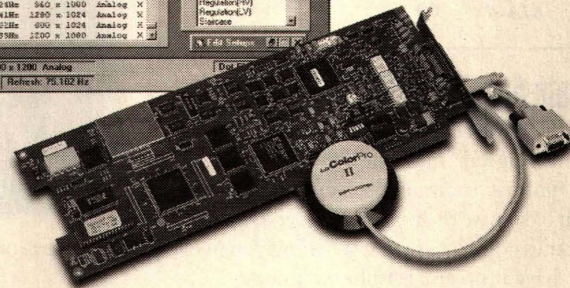
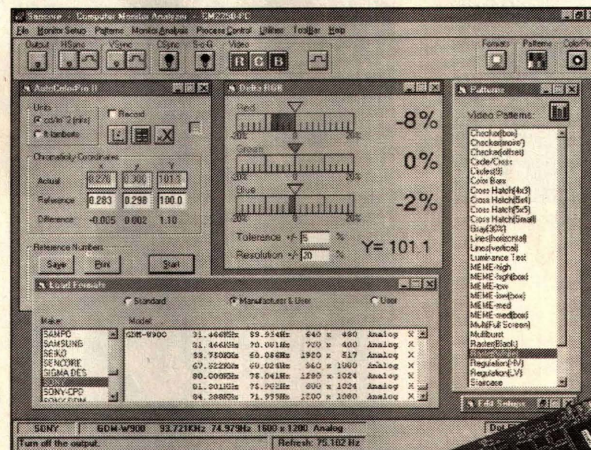
3200 Sencore Drive

Sioux Falls, SD 57107

Tel: 800-SENCORE or 605-339-0100

Fax: 605-339-0317

Web: www.sencore.com



CIRCLE 20 ON FREE INFORMATION CARD

Single-Board Computer

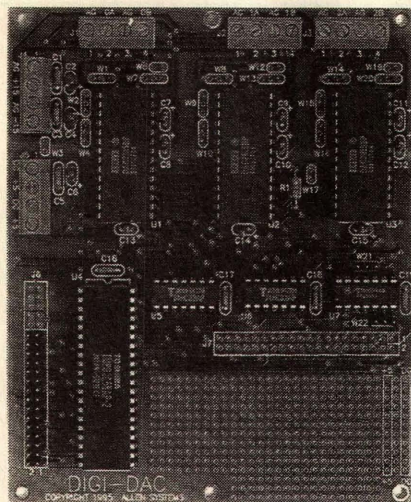
IDEALLY SUITED FOR LABORATORY use the MICRO LAB-51 is an 8051-based single-board computer that has a small footprint of 4.5 by 4 inches. It works well in both educational and product development settings. In an academic environment, instructors can demonstrate real-world applications and students can implement projects. In the development lab, design engineers can easily create and test prototypes of their 8051-based products.

In its standard configuration, the board has a full-featured BASIC interpreter that supports floating-point math and most BASIC commands. An advanced version, which comes with system-monitor debugger software and an optional 8051 cross assembler, is also available. Suitable for 8051-based product development, that configuration enables the engineer to write assembly-language code and then run it in real time under monitor control.

The MICRO LAB-51 uses the

89S8252 microcontroller, which is 8051-compatible and runs at up to 24 MHz. A feature of the 89S8252 is that its 8 kilobytes of flash memory can be programmed serially, facilitating software upgrades even after the board has been placed into an application. In addition to the 89S8252, there are two 28-pin memory sockets. The first supports 32K of RAM, while the second supports 28K of EEPROM, EPROM, or battery-backed RAM.

Other board features include RS-232 serial-port buffering (RS-485 is optional), a processor supervisory circuit with a manual reset switch, and an ample prototyping area that measures 3.5 by 1.5 inches. Data, address, and control lines are conveniently brought out on connectors next to the prototype area, making it a snap to add custom-user circuitry. The MICRO LAB-51 comes either fully assembled and tested or in kit form. The kits sells for \$99, and the assembled and tested unit sells for \$139.



CIRCLE 21 ON FREE INFORMATION CARD

ALLEN SYSTEMS

2345 Brandon Road
Columbus, OH 43221
Tel: 614-488-7122

Data-Acquisition DMM

WITH THIS NEW DATA-ACQUISITION digital multimeter, you will be acquiring, analyzing, saving, or transmitting data in no time flat. The DM9100 comes complete with everything you need to have it up and running in minutes.

The meter, which meets CE requirements, performs true rms AC-, decibel-, capacitance-, and inductance-measurement, as well as temperature measurement in Celsius or Fahrenheit. Among its features are dual display, RS-232C-interface, 10-location memory, time/mode with alarm, average and relative mode, automatic power-off and "keep-on" mode, data-hold and run mode, and minimum/maximum readings.

Measuring $7.8 \times 3.5 \times 1.5$ inches and weighing approximately 1 pound, the DM9100 also offers a pulse-signal injection function, a logic-probe function, a continuity and diode test, a back light, and a clock and stopwatch. Designed for safety, the instrument has warning signals and overload protection built in.

The DM9100 has a list price of \$209.95. Just supply your own computer and the meter, along with its software and the RS-232C-interface, will do the rest.

A. W. SPERRY INSTRUMENTS, INC.

245 Marcus Blvd.
Hauppauge, NY 11788
Tel: 800-645-5398 or 516-231-7050
Fax: 516-434-3128

e-mail: cat@awsperry.com

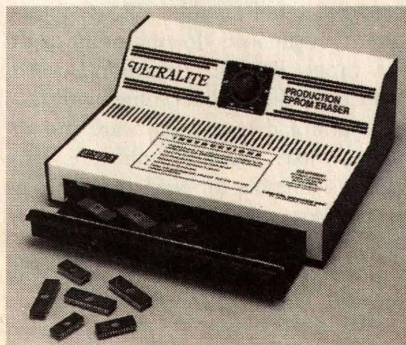


CIRCLE 22 ON FREE INFORMATION CARD

EPROM Eraser

THE ULTRALITE MODEL UV EPROM eraser is an industrial-grade model suitable for production as well as engineering applications. It accommodates PC boards and up to 50 erasable devices. The unit's two 8-watt UV bulbs, which have a 7700-hour life span, will erase a full tray of devices in 15-20 minutes.

The Ultralite features a slide-out tray (9 by 6 by $\frac{3}{4}$ inches) and a convenient automatic shut-off timer. A safety switch turns off the UV light when the tray is open. It has a list price of \$299.



CIRCLE 23 ON FREE INFORMATION CARD

LOGICAL DEVICES, INC.

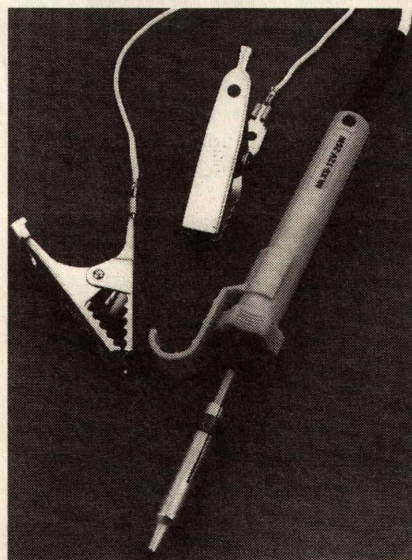
1221 S. Clarkson Ave., Suite 200
Denver, CO 80210
Tel: 303-722-6868
e-mail: logdev@logicaldevices.com
Web: www.logicaldevices.com

Portable Soldering Iron

DESIGNED TO MAKE FIELD REPAIRS virtually anywhere, the Antex MLXS-12 Repair Kit features a 25-watt portable soldering iron that clips to the terminals of any automotive-type 12-volt battery. The soldering iron uses heavy-duty alligator clips and comes with a 15-foot power cord to reach the part that needs soldering.

Heating up to 800°F in under two minutes, this portable iron lets users make field repairs without the use of butane torches and hazardous flames. The tool is designed with the heating element under the tip for optimum thermal efficiency.

Packaged in a handy vinyl pouch, the Antex MLXS-12 Repair Kit is priced at \$39.95 and comes with a standard tip and an emergency supply of solder. It easily fits into a tool box, under a seat, or in the glove compartment. Literature is available upon request.



CIRCLE 24 ON FREE INFORMATION CARD

M.M. NEWMAN CORP.

24 Tioga Way
P. O. Box 615
Marblehead, MA 01945
Tel: 781-631-7100
Fax: 781-631-8887
e-mail: mmmn@mmnewman.com
Web: www.mmnewman.com



NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

PCI Hardware and Software: Architecture & Design, Fourth Edition

by Edward Solari and George Willse
Annabooks

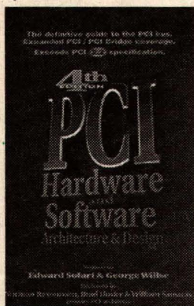
11838 Bernardo Plaza Court, Suite 102A
San Diego, CA 92128

Tel: 800-462-1042 or 619-673-0870

Fax: 619-673-1432

Web: www.annabooks.com

\$97.95



CIRCLE 338 ON FREE
INFORMATION CARD

An essential guide-book for engineers using PCI in their designs, the book is thoroughly illustrated with detailed schematics and drawings. This edition, which presents detailed information about the new PCI2.2 specification, covers handling of Posted Memory Writes and new Power Management Event commands, as well as timing requirements to support Hot-Plug and Power Management capabilities. Information on the Retry Timer and Maximum Retry Time (MRT) has also been included.

Providing a complete PCI overview, the almost 900-page book discusses the relationship of PCI to the ISA bus and to Plug-and-Play architecture. Including all electrical, mechanical, and system-level aspects of PCI architecture, this edition discusses topics such as functional interaction between PCI resources, signal-line definition, detailed bus-cycle operation, cache support on PCI, master and target termination, bus ownership, parity and bus errors, reset, and power and signal-line initialization. Also covered is signaling timing and electrical requirements; connector, platform, and add-in card design; latency and performance; mechanical specifications; system resources; PCI configuration address space;

system BIOS; PCI system BIOS interface; and PCI-device configuration.

The eleven appendices offer information on new capabilities, Vital Product Data (VPD), PCI class code-register encoding, user-definable configuration items, VGA palette snooping, PCI and ISA aliasing, electrical specification notes, and common problems to avoid.

1999 Catalog

DC Electronics

P.O. Box 3203

Scottsdale, AZ 85271-3203

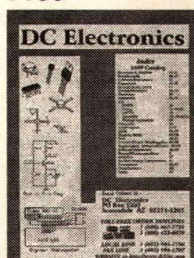
Tel: 800-467-7736 or 800-423-0070;

602-945-7736

Fax: 602-994-1707

Web: www.dckits.com

Free



CIRCLE 339 ON FREE
INFORMATION CARD

This new catalog from DC Electronics offers a wide range of products and kits for the electronics hobbyist. Among the offerings are high-performance audio kits, batteries, breadboards, cabinets, capacitors, crystal radio parts, diodes, rectifiers, heatsinks, LEDs, printed-circuit kits and supplies, replacement semiconductors, Basic Stamps and microcontrollers, surface-mount components, transistors, and tools, and more. Among the new offerings are a line of microcontroller-based PLL FM transmitters (for both the FM band and 49 MHz), a switchbox project, tiny CCD cameras, and RF transistors.

BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: **(800) BOOKS-NOW (266-5766)** or **(801) 261-1187** ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronics-now.htm>.

Free catalogs are *not* available.

In addition, the catalog offers tips on reading resistor and capacitor values, designing bridging circuits, and a guide to data resources. DC Electronics' Web site, listed above, provides updates, new products, and links to major semiconductor manufacturers, where data sheets can be found.

The Design of CMOS Radio-Frequency Integrated Circuits

by Thomas H. Lee

Cambridge University Press

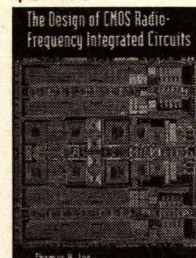
110 Midland Avenue

Port Chester, NY 10573

Tel: 800-872-7423 or 914-937-9600

Web: www.cup.org

\$54.95



CIRCLE 340 ON FREE
INFORMATION CARD

Comprehensive and insightful, this book details how to design gigahertz-speed radio-frequency ICs in CMOS technology. An ideal textbook for graduate students or anyone taking graduate courses in RF electronics, as well as a useful reference for engineers, it contains over 350 circuit diagrams and illustrations plus numerous homework problems.

Starting with a history of radio, the author provides a solid foundation on this subject. He also presents the differences between the discrete era and the IC age. Among the topic reviewed are passive RLC networks, characteristics of IC components, and transistor models. Techniques of designing high-frequency tuned and broadband amplifiers are covered, with an emphasis on approximate methods that provide important design insight as a complement to simulation results.

Key RF building blocks, such as low-noise amplifiers (LNAs), mixers, power amplifiers, high-spectral-purity oscillators,

tors, and frequency synthesizers, are studied in detail. The book closes with an examination of transceiver architectures.

North American Repeater Atlas, 1998/99 Edition

by Bob Martin, N7JXN

The American Radio Relay League

225 Main Street

Newington, CT 06111-1494

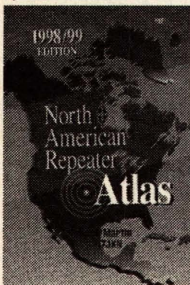
Tel: 860-594-0200

Fax: 860-594-0259

e-mail: bq@arrl.org

Web: www.bq@arrl.org

\$12



CIRCLE 341 ON FREE INFORMATION CARD

This book is what every ham needs—whether on a business trip, touring the country in a RV, or traveling in unfamiliar territory. Written for the ham on the go who wants to keep in touch with nearby repeaters, the completely revised Atlas is a handy and useful reference.

It contains over 175 pages of repeater maps—for all 50 states, every Canadian province, and for all of Mexico, Central America, and the Caribbean. In addition, there are street maps showing repeater frequencies for most U.S. metropolitan areas. The book starts with maps of U.S. 10- and 6-meter repeaters. Geographical maps also include facts about the area being shown. Repeater information—including frequency, sub-audible tone (if necessary), and indications of which repeaters have autopatch capability—is provided. The Atlas includes repeater listings for 10 meters, 6 meters, 2 meters, 222 MHz, 440 MHz, 900 MHz, and 1.2 GHz.

Other features of the Atlas are the inclusion of information for contacting Frequency Coordinators, as well as guidelines for repeater use.

License Your Invention

by Richard Stim

Nolo Press

950 Parker Street

Berkeley, CA 94710

Tel: 510-549-1976

Fax: 510-548-5902

Web: www.nolo.com

\$39.95



CIRCLE 342 ON FREE INFORMATION CARD

Brilliant inventions are much more common than brilliant inventions that make money. The difference is in knowing how to get an idea to the right market and not get ripped off in the process. The author, an attorney and intellectual-property expert, tells inventors everything they need to know to enter into a solid licensing agreement.

Detailed instructions are given on how to work with manufacturers, marketers, and distributors who handle the details of merchandising an invention. The book shows step by step how to draft a license that will be fair to all parties. It addresses issues like ownership; applicable patent, copyright and trademark laws; license scope; dispute resolution; and finances.

Readers learn about the licensing process—they learn how to determine ownership rights, to find potential licensors, to understand and negotiate fair terms for a licensing deal, to draft a comprehensive licensing agreement, and to review and negotiate changes to a licensor's proposed agreement. In addition, the book helps inventors determine ownership rights and explains how to show the invention to others without getting ripped off. Sample tear-out agreements for anyone patenting an invention in the U.S. are provided, and all the necessary licensing forms are on the included disk.

1998-1999 Full-Line Catalog

Sencore

3200 Sencore Drive

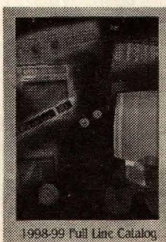
Sioux Falls, SD 57107

Tel: 800-SENCORE or 605-339-0100

Fax: 605-339-0317

Web: www.sencore.com

Free



CIRCLE 343 ON FREE INFORMATION CARD

Designed as a one-stop shop for all Sencore's offerings, this 69-page catalog contains solutions to modern servicing challenges. It features over ten new products and 29 other products. There are numerous color photos, and specifications, and accessories clearly listed.

BooksNow

To order books in this magazine or

any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.

Eight service areas are covered, including Instruments for Computer Monitor Servicing, TV Analyzing, and VCR/Camcorder Analyzing and General Analyzing; Service Center Management Software; TV-RF Distribution Analyzers; Tech Training; and Tech Disc Multimedia Services. Also in the catalog are Value-Added Business Building Resources that help service centers improve their offerings within their business.

Morse Code: Breaking the Barrier

by Dave Finley, N1IRZ

MFJ Enterprises, Inc.

300 Industrial Park Road

Starkville, MS 39759

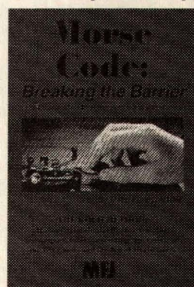
Tel: 800-647-1800

Fax: 601-323-6551

e-mail: mjf@mfjenterprises.com

Web: www.mfjenterprises.com

\$14.95 plus shipping



CIRCLE 344 ON FREE INFORMATION CARD

In 1936, Ludwig Koch, a German psychologist, published the results of extensive research on Morse Code proficiency and showed how he trained students to copy at 12 words per minute in as little as 13.5 hours.

That is by far the fastest Morse training program ever published, but it didn't become widely known.

According to author Dave Finley, "Very simply, Koch's technique was ahead of the technology of his time. For most people, the kind of practice you need wasn't available until microprocessors came along." In this book, Finley shows how, using a computer or a microprocessor-based pocket code-trainer (MFJ-418), today's hams and would-be hams can use Koch's technique to build high-speed code proficiency quickly and efficiently. Besides its speed, Koch's method has another advantage: it gives students frequent positive reinforcement, which means that people see results and stick with their training. **EN**

1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



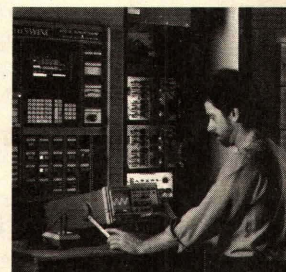
CIE's Associate Degree program contains 397 lab experiments.

2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

FREE CATALOG



1776 E. 17th Street
Cleveland, Ohio 44114-3679

Visit Our Web-Site
www.cie-wc.edu

☐ **YES!** I am interested.
Please send me a catalog.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

A school of thousands. A class of one. Since 1934.

AE138

RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

California

California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

Gateway Electronics of CA
9222 Chesapeake Drive
San Diego, CA 92123

Mac's Electronics
191 South "E" Street
San Bernardino, CA 92401

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Orvac Electronics
1645 E Orangethorpe Ave.
Fullerton, CA 92631

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove, CA 92643

JK Electronics
6395 Westminster Blvd.
Westminster, CA 92683

Kandarian Electronics
1101 19th Street
Bakersfield, CA 93301

Whitcomm Electronics
105 W. Dakota #106
Clovis, CA 93612

Minuteman Electronics
37111 Post St., Suite 1
Fremont, CA 94536

HCS Electronics
6819 S. Redwood Drive
Cotati, CA 94931

Halted Specialties Co.
3500 Ryder Street
Santa Clara, CA 95051

Metro Electronics
1831 J Street
Sacramento, CA 95814

HSC Electronics
4837 Amber Lane
Sacramento, CA 95841

Colorado

Gateway Electronics of CO
2525 Federal Blvd.
Denver, CO 80211

Centennial Electronics
2324 E. Bijou
Colorado Sps., CO 80909

Connecticut

Cables & Connectors
2198 Berlin Turnpike
Newington, CT 06111

Electronic Service Prod.
437 Washington Avenue
North Haven, CT 06473

Florida

P. Benavides Corp.
3900 NW 79 Ave. Suite 600
Miami, FL 33166

Georgia

Normans Electronics Inc.
3653 Clairmont Road
Chamblee, GA 30341

Illinois

Tri State Elex
200 W. Northwest Hwy.
Mt. Prospect, IL 60056

Maryland

Mark Elec. Supply Inc.
5015 Herzel Place
Beltsville, MD 20705

Amateur Radio Center
1117 West 36th Street
Baltimore, MD 21211

Massachusetts

U-Do-It Electronics
40 Franklin Street
Needham, MA 02194

Michigan

Purchase Radio Supply
327 East Hoover Avenue
Ann Arbor, MI 48104

Norwest Electronics
33760 Plymouth Rd.
Livonia, MI 48150

The Elec. Connection
37387 Ford Road
Westland, MI 48185

Elec. Parts Specialists
711 Kelso Street
Flint, MI 48506

Minnesota

Acme Electronics
224 Washington Avenue N.
Minneapolis, MN 55401

Missouri

Gateway Electronics of MO
8123-25 Page Blvd.
St. Louis, MO 63130

New Jersey

Lashen Electronics Inc.
21 Broadway
Denville, NJ 07834

New York

LNL Distributing Corp.
235 Robbins Lane
Syosset, NY 11791

Unicorn Electronics
Valley Plaza
Johnson City, NY 13790

Ohio

Philcap Electronic Suppliers
275 E. Market Street
Akron, OH 44308

Oregon

Norvac Electronics
7940 SW Nimbus Avenue
Beaverton, OR 97005

Texas

Tanner Electronics
1301 W Beltline
Carrollton, TX 75006

Mouser Electronics
958 N. Main Street
Mansfield, TX 76063

Electronic Parts Outlet
3753 B Fondren
Houston, TX 77063

Computers Electronics Etc.
110 E. Medical Center Blvd.
Webster, TX 77598

**If you'd like to sell our magazine in your store,
please circle 210 on free information card
or
Contact Gina Gallo at (516) 293-3000 ext 223**

THE REAL McTUBE



FRED NACHBAUR

With the phenomenon of the "retro" movement in music electronics, there has been renewed interest in the vacuum tube. Several manufacturers are again building tube amplifiers and other devices, with claims of "vintage sound" and "warm-tube distortion."

But are vacuum-tube-based amplifiers really "better" than solid-state units? That is an argument that might never be resolved; the "sound" of a particular piece of equipment is as much the listener's perception as the specifications of the amplifier circuit.

The only sure-fire way to find out if tube-based gear is right for you is to try one out. With the Real McTube device presented here, you can experiment with these interesting devices by building a tube pre-amplifier and distortion unit. The overall cost of the project will

Give your music a real "retro" sound with this vacuum-tube based preamplifier.

depend on how many parts you already have in your junk box, but it shouldn't be over about \$50 if you shop carefully. The only part you might have trouble finding is the vacuum tube itself (along with the 9-pin miniature tube socket to go with it). Although vacuum tubes are again being manufactured in quantity (mainly in Russia), they haven't quite made it back onto the shelves of most electronics shops. If you are stuck, one source might be a musical-instrument-repair shop that specializes in vacuum-tube gear. There are also a number of companies that sell these mail order, and a number have a presence on the

Internet. Some of these are STF Electronics, 171 Springlake Dr., Spartanburg, SC 29302, Tel: 864-573-6677; SND Tube Sales, 5389 Ville Rosa La, Hazelwood, MO, Tel: 314-770-0119; Tube World, Inc., 2717 Superior Av, Sheboygan, WI 53081.

The Tube Sound. So what is it about tubes that make them sound different from solid-state devices like transistors? There is really nothing mystical about it; in reality, their unique sound derives more from their shortcomings than from anything else. Being hot, bulky and expensive, manufacturers couldn't afford to make amplifiers with massive gain, which would have let them use large amounts of negative feedback to linearize the amplifier's response and reduce distortion. The exception was for applications such as studio monitors and similar high-end equipment. You only have to lis-

There are wide variances in those characteristics between tubes of a

The 12AX7 is but one of a whole family of dual-triodes tubes. Other devices in the family are the 12AT7, 12AU7, 12AY7, 12AZ7, and numerous European types. The filament (heater) requirements are all the

Basic Tube Theory. Unlike transistors, tubes require at least two power supplies. Before the advent of universal home power, tube-based electronic gear was operated on batteries. One battery (called the "A" battery) was needed for the low-voltage, relatively high-current supply to heat the tube's filament. Another battery (the "B" battery) was the high-voltage, low-current battery used to power the tube's plate circuit. That labeling convention has persisted to this day; if you ever wondered why you hear of devices connected to "B+", now you know. In the

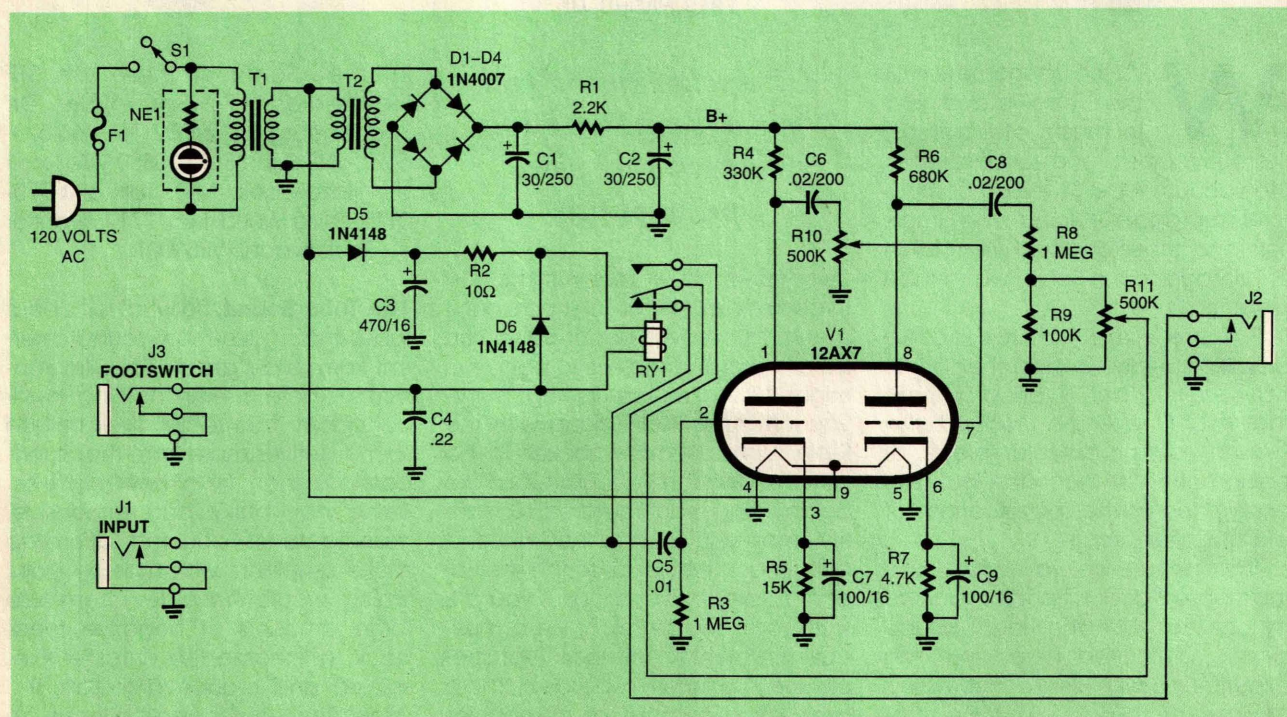


Fig. 1. The Real McTube is simply a two-stage, non-inverting preamplifier. Using a vacuum tube for the active element can create many interesting sounds—something musicians are always looking for!

early days, there was even a "C" battery. It was used to provide the negative-grid bias for some circuits. That need didn't continue for very long except in special radio applications because the negative-grid bias can usually be obtained by using a cathode resistor; that trick is used in the Real McTube.

Tubes are roughly analogous to field-effect transistors (FETs) in that they are *voltage amplifiers*; bipolar transistors amplify current. The tube's cathode is like the FET's source, the grid is the gate, and the plate is the drain. Like FETs, tubes have a near-infinite input impedance, and a high output impedance. The most widely-used tube configuration—the common-cathode arrangement—is quite similar to the common-source FET-amplifier configuration. But the similarity ends at that point.

Physically, a tube operates by heating the cathode, one of the electrodes inside the evacuated glass envelope. That causes electrons in the cathode to attain enough velocity to leave the surface, forming a "space charge" around the cathode. The positively-charged plate (also called the *anode*) surrounds the cathode with the cathode being at the center. The plate attracts the space charge, causing an electron current to flow through the space between the cathode and plate. If the plate is negatively charged, the space charge is repelled and no current flows; that is how the vacuum diode works.

In what's called a *vacuum triode*, there is another electrode called the *grid* that is placed between the cathode and the plate. It usually consists of a spiral screen of fine wire. The grid is normally biased negatively so that it does not act as a secondary plate and draw current. Small changes in voltage on the grid cause significantly greater changes in electron current through the tube from cathode to plate, resulting in amplification.

As the vacuum tube was developed, additional grids were added to form first the *tetrode*, then the *pentode*. The culmination of multi-grid mania was the *heptode*, which is a five-grid device that was once used extensively as the oscilla-

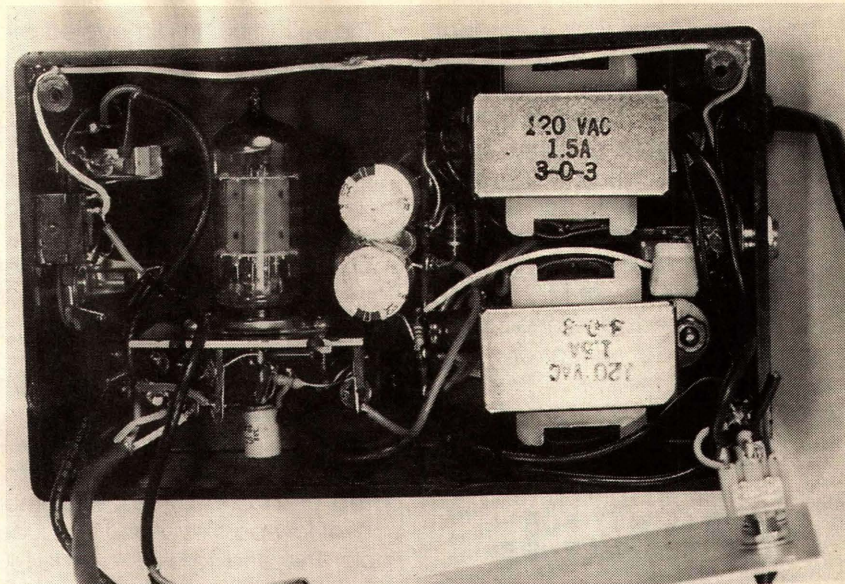


Fig. 2. Here is the author's prototype for the Real McTube. While a smaller case makes for a portable unit, assembly can be difficult.

tor/mixer in home radio receivers.

When dealing with vacuum tubes, it makes sense to consider current flowing from the negative terminal to the positive terminal of the "B" supply because that's what physically happens. That is called the *electron-current* convention, and was taught in most technologist courses up until a couple of decades ago. The problem with that convention is that the algebraic signs end up backwards in circuit design and analysis. Engineering courses thankfully used the opposite convention, called *conventional-current* flow, in which current is assumed to flow from positive to negative. That has the advantage in semiconductor circuits of making the arrows in diode and transistor symbols point in the right direction. When dealing with tubes, however, which convention you use is strictly a matter of personal preference.

Finally, it should be pointed out that unlike transistors, tubes come in only one polarity because we only have one type of charge carrier—electrons. Unlike solid-state technology, no one has yet to figure out how to make holes in a vacuum. I suppose it's theoretically possible to make tubes out of antimatter in order to get "PNP" tubes, but storage and interfacing could be a bit of a headache. Such devices will probably remain in the realm of science fiction.

How It Works. The Real McTube is a simple circuit; it can be seen in Fig. 1. Line current is applied through F1 and S1 to the primary of T1. A neon bulb with an integral resistor, NE1, indicates whenever the Real McTube is turned on. The secondary of T1 provides the 6.3 volts needed to power the tube's heater filament. The tube filaments are connected in series with a center tap. Since we are supplying 6.3 volts, power is connected to the center tap; the other sides of the filaments are grounded. The tube is set up that way in order to use either a 6.3-volt or a 12.6-volt "A battery". With a 6.3-volt source, the filaments are effectively wired in parallel. If T1 were a 12.6-volt transformer, the two end terminals of the heaters would be used, leaving the center tap unconnected; that would put the heaters in a series circuit.

The output of T1 also provides voltage to bypass relay RY1. Diode D5 half-wave rectifies the voltage, and C3 filters and smoothes the pulsating DC in order to prevent noise and relay chattering. Resistor R2 limits the current draw by RY1 and provides a small voltage drop for the relay. Diode D6 absorbs any voltage spikes that are generated when RY1 turns off. Capacitor C4 helps to eliminate any transients that might cause audible clicks when RY1 changes state.

Jack J3 is wired in such a way that when nothing is plugged into it, RY1 is engaged whenever the unit is turned on. That way, the input signal from J1 is routed through the pre-amp circuit to J2. If the unit is turned off, the relay disengages and the signal is routed straight through. A simple single-pole, single-throw footswitch is plugged into J3; it lets the Real McTube be used or bypassed as needed without having to disconnect or move any wires. The footswitch is simply wired to short the contacts of J3 in order to operate RY1.

PARTS LIST FOR THE REAL MCTUBE

SEMICONDUCTORS

D1-D4—1N4007 silicon diode
D5, D6—1N4148 silicon diode

RESISTORS

(All resistors are 1/4-watt, 5% metal-film units unless otherwise indicated.)

R1—2200-ohm
R2—10-ohm
R3, R8—1-megohm
R4—330,000-ohm, 1/2-watt
R5—15,000-ohm
R6—680,000-ohm
R7—4700-ohm
R9—100,000-ohm
R10, R11—500,000-ohm panel-mount potentiometers, audio taper

CAPACITORS

C1, C2—30- μ F, 250-WVDC, electrolytic
C3—470- μ F, 16-WVDC, electrolytic
C4—0.22- μ F, ceramic-disc
C5—0.01- μ F, 100-WVDC, ceramic-disc
C6, C8—0.02- μ F, 200-WVDC, Mylar
C7, C9—100- μ F, 16-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

F1—0.25A, 125-volt AC fuse, slow-blow
J1, J3—1/4-inch mono switching jack
J2—1/4-inch mono jack
NE1—Neon indicator, 125-volt AC, with built-in resistor
RY1—Single-pole, double-throw relay, 6-volt DC coil
S1—Single-pole, single-throw switch, 125-volt AC contacts
T1, T2—6.3-volt, 1.5-amp filament transformer
V1—12AX7 dual-triode vacuum tube
Power cord and plug, strain relief, enclosure, 9-pin miniature chassis-mount tube socket, SPST footswitch, mounting bracket for tube socket, knobs, hardware, terminal strips, wire, shielded cable, etc.

The output from T1 is coupled into an identical transformer, T2, that is wired "backwards." That steps the voltage back up to about 110 VAC for the plate supply, or "B battery." That arrangement has the advantage of providing line isolation for the Real McTube, reducing the chance of short circuits or shocks of damaging any equipment that is plugged into the Real McTube—including the operator!

Diodes D1-D4 form a full-wave bridge rectifier for the B+ voltage. Capacitor C1 filters the resulting pulsating DC, and the network composed of R1 and C2 adds another pole of low-pass filtration to reduce ripple. The end result is about 140 volts DC under load to power the plate circuits of the Real McTube.

An audio signal from J1 is coupled to the grid of the first stage through C5. Input resistor R3 serves a dual function. Primarily, it acts as a "grid leak" to prevent any electrons that accumulate on the grid from piling up on C5; the resulting negative voltage would eventually cause the tube to approach cut-off. Secondly, it serves to bias the grid at very near ground potential.

The plate-load resistor is R4. The varying plate current flowing through R4 causes a voltage drop that is proportional to the change in current. Therefore, R4 plays a major part in defining the voltage gain of the amplifier stage.

The plate current also flows through cathode resistor R5, causing a smaller voltage drop across it. The result is that the cathode is positive with respect to ground. Since the grid is at (or close to) ground potential, it follows that the grid will be negative with respect to the cathode. That is how we get the necessary negative-grid bias without having to resort to a third power supply—the "C" battery. Capacitor C7 "shorts out" any AC signal component, eliminating the negative feedback that would otherwise result. That has two major effects: first, it maximizes the voltage gain, making it easier to achieve overdrive; and secondly, it eliminates any reduction in non-linearity distortion that would defeat the purpose behind the Real McTube—getting "that tube sound."

The signal output at the plate of the first stage is coupled into a similar stage by capacitor C6 and gain control R10. The component values in the two stages were chosen more or less experimentally to suit the author's personal tastes.

The output of the second stage is routed through an attenuator consisting of R8, R9, and output control R11. The accumulated gain after the second stage is so high that the absence of an attenuator would make it ridiculously difficult, if not impossible, to adjust the controls for varying degrees of overdrive. The wiper of R11 is the output of the Real McTube. The final signal passes through the contacts of RY1 to output jack J2.

Building the Real McTube. The prototype for the Real McTube was built in a plastic box with an aluminum lid for the controls; the size of the unit was large enough to hold all of the components yet small enough to be portable. Admittedly, the resulting layout is a little tight—the layout of the author's prototype is shown in Fig. 2.

As in most traditional vacuum-tube units, there is no PC board for the Real McTube; all of the components are mounted onto terminal strips and connected directly to each other. The tube socket was mounted on an L-shaped metal bracket that measures about 2-inches square with terminal strips mounted to the same screws that are used to hold the socket to the bracket. The various biasing and coupling components are then soldered between the socket and the terminal strips.

The power supply was built in the case itself, again using terminal strips to hold all of the components except the transformers, S1, and NE1. The input and output jacks were installed on the front of the box, and the remote footswitch jack on the rear.

You might want to leave yourself a bit more space for experimenting—if so, you should obviously use a larger box. With a single 12AX7, heat is not a big consideration so you don't have to worry about ventilation. Orientation of the tube doesn't matter either; the 12AX7 family can

operate in any orientation—which is not necessarily a given for all tubes!

Be careful about wiring, especially in the comparatively high-voltage plate circuits. Be sure to use capacitors that will stand the voltage; most standard ceramic-disc capacitors are only rated for 25 or 50 volts. Having a capacitor explode into flames a few minutes after powering up the Real McTube for the first time is definitely an experience that you'd like to avoid at all costs! On a similar note, it is also a good idea to stay away from carbon-composition resistors, especially for R4 and R6, or you can get another classic tube sound—lots of hiss.

All of the signal lines, such as the lines to J1, J2, and RY1 should be wired with good quality shielded cable. A good choice would be the RG174 variety. Keep the component leads as short as possible by mounting them as close to their associated tube socket pins as is practical. The input to the first stage is especially critical; we're dealing with a very high input impedance and low signal level. Hum and noise pickup is a real concern under those conditions.

Some components in the power supply can be substituted without affecting the operation of the Real McTube; if you have an item on hand, it can help keep the cost of the project down. For example, the 6-volt transformers can be replaced with 12-volt units. If you do that, the tube's heaters will need to be wired in series instead of in parallel as shown. Simply connect the supply to pins 4 and 5; leave pin 9 unconnected. A 12-volt relay will also have to be used for RY1. If you want to use 12-volt transformers but have a 6-volt relay, increase the value of R2 to compensate. That is done by measuring the DC resistance of the

relay coil and choosing the next higher standard value for R2. For example, if the resistance of your relay is 50 ohms, use a 56-ohm resistor for R2.

Diodes D1-D4 can be substituted with a single bridge rectifier.

One important safety consideration: **DO NOT** be tempted to omit the second transformer! Although the circuit will work if you derive the 120 VAC directly from the line, you can seriously injure or even kill yourself or somebody else. At best, you can ruin your gear if you don't isolate the high-voltage supply from the AC line.

Testing the Real McTube. Once the circuit is wired up, stop and check your work for errors or accidental shorts. Once you are satisfied with your workmanship, plug the unit into a wall socket and turn it on *without* V1 being plugged into its socket. With a voltmeter, measure the voltages at pins 1 and 6 of the tube socket; you should read about 145 volts DC. At pin 9, you should read about 7 volts AC. At all of the other pins, you should read 0 volts.

If all is well so far, unplug the unit and insert the tube into the socket. You should be careful not to accidentally touch the filter capacitors—they will carry a residual charge under those conditions. A good safety tip is to short them to ground with a 1000-ohm resistor for several seconds whenever you work on the unit after having powered it up. While monitoring the B+ voltage at the positive end of C2, turn the unit on. You should see the heaters in the tube start to glow. After about 10 seconds, the B+ voltage should sag a bit as the triodes start conducting. The voltage should drop no lower than about 135-140 volts DC.

Measure the voltages on the pins

of the tube again. If you used the component values suggested, your readings should be close to the values shown in Table 1. If the plate voltages are excessively low or if one or both of the grids are positive with respect to ground, power down right away and find the problem. The same advice applies if you see blue flashes in the tube or smell anything unusual. Re-examine your work and double-check the values of the components. Be sure that you are using good quality Mylar or similar capacitors for C6 and C8, and that they have at least a 150-volt rating.

Assuming that the voltages are correct, turn the unit off. Connect the output to an amplifier and the input to your instrument. Turn the gain and output controls to minimum, and power up. Slowly bring up the controls until you hear your instrument through your amplifier.

With the Real McTube working, you can now start using and experimenting with it.

Using the Real McTube. What sound you get from your guitar or other instrument with the Real McTube will depend greatly on the settings of the various controls—specifically, the volume and tone controls on your instrument and the Real McTube's gain control. The output control has little or no effect on the sound, and is used primarily to balance the volume of the sound through the unit.

Note that both stages are inverting amplifiers; the overall phase of your signal will therefore not change. However, the adjustments of your controls will determine what portion of your signal will be clipped. The first stage will tend to clip more on negative half-cycles as the tube reaches cutoff—remember the discussion above regarding cutoff versus saturation. The second stage, however, will tend to clip more on positive half-cycles, since it sees an inverted signal at its input. By carefully balancing your instrument controls and the gain control, virtually any distortion sound from a mild "warm-fuzzy-feeling" to a hard "monster-metal-shred-head" sound, with lots of odd-harmonic distortion, can be attained.

A compressor before the Real

(continued on page 50)

**TABLE 1—
VOLTAGE MEASUREMENTS AT V1**

Pin	Description	Voltage
1	Plate A	+108 VDC
2	Grid A	-0.001 VDC
3	Cathode A	+1.5 VDC
4,5	Filaments	0 volts
6	Plate B	+60 VDC
7	Grid B	-0.1 VDC
8	Cathode B	+0.7 VDC
9	Filament	6.3 VAC

BUILD THE Q-SORT

What do you do when you need to test and sort your ever-growing collection of bipolar-junction transistors (BJTs) or a newly-purchased "economy assortment?" To make matters worse, that "economy assortment" might have (horror of horrors!) "house" part numbers that have no relation to the actual devices that they're supposed to be. You could use a digital voltmeter (DVM) with a built-in transistor tester; these days, such DVMs are readily available. But when you're looking at 20 to 40 unknown BJTs, the thought of swapping the test leads up to six times for each transistor (as well as changing the NPN/PNP switch for each lead position) is pretty discouraging. If you're lucky enough to have "real" part numbers, you could look them up in a semiconductor-replacement guide, which usually takes longer than using a DVM in the first place.

Clearly, a better way is needed. That is why the Q-Sort was created. With the Q-Sort, you can test and sort up to 40 unknown BJTs in less than six minutes—without touching an NPN/PNP selector switch or swapping a test lead! The Q-Sort can tell you if a BJT is an NPN or a PNP type, as well as identifying the emitter, base, and collector terminals. There are no adjustments to make, and you won't waste time changing Q-Sort's NPN/PNP selector switch because it doesn't have one. It automatically determines if a BJT is an NPN or a PNP, and turns on one of two LEDs to display the transistor type. All that you have to do is insert the transistor into the Q-Sort's test slots (or use the built-in test leads) and rotate a six-position switch to determine the transistor's emitter, base, and collector leads.

It's practically effortless and best of all—it's fast! Why spend up to \$200 on a transistor tester/sorter



Test and sort those bipolar transistors in a jiffy!

LARRY BALL

when the Q-Sort can be built for under \$20? Of course, the Q-Sort won't give you all the features of a full-featured transistor tester/sorter. For example, the Q-Sort does not measure gain, but a DVM with a built-in h_{fe} test can be purchased for less than \$17. Chances are that you might already have such a DVM available.

Circuit Description. The Q-Sort consists of three sections: a three-pole, three-position switch, an oscillator; and a polarity-reversing circuit for the oscillator's power supply.

We'll look at the polarity-reversing circuit first. As shown in Fig. 1, IC1 is set up as an astable multivibrator. Its output (labeled OUTPUT A) is a 10-Hz squarewave with an amplitude from ground to about 1½ volts less than the power supply. That signal is coupled through R3 and R4 to Q1 and Q2. Those transistors invert the 10-Hz squarewave, labeled OUTPUT B.

Together, the two signals provide an AC squarewave to the oscillator section. Using that signal is how the Q-Sort determines if a transistor under test is an NPN or a PNP type without using a polarity switch. Transistors Q1 and Q2 do that by grounding OUTPUT B when OUTPUT A is high, and by connecting OUTPUT B to the power supply when OUTPUT A is grounded. Non-polarized capacitor C3 smoothes the output of OUTPUT A and OUTPUT B.

A tapped-coil oscillator is formed by R5, R6, C4, T1, and the transistor under test. Light-emitting diodes LED1 and LED2 are connected to the secondary winding of T1. When a BJT is correctly connected to the test leads or J1, the circuit will oscillate for half the time regardless

of whether the transistor is an NPN or a PNP because of the circuit's AC input. However, since an NPN or a PNP transistor placed in the circuit will conduct in opposite directions, the transistor's type can be displayed with LED1 (for NPN types) or LED2 (for PNP types).

The Q-Sort will not oscillate unless the transistor under test is connected correctly. By turning S2, the three lead wires to J1 (or the built-in test leads) are quickly and easily swapped among the various possible combinations of connec-

SOURCES OF PARTS AND MATERIALS

4-position, 6-pole switch:
Mouser Electronics
958 N. Main St.
Mansfield, TX 76063-4827
800-346-6873
part number: 10WR046

Budget priced DVM with built-in h_{fe} tester:
Hosfelt Electronics Inc.
2700 Sunset Blvd.
Steubenville, OH 43952
800-524-6464
part number: 9202

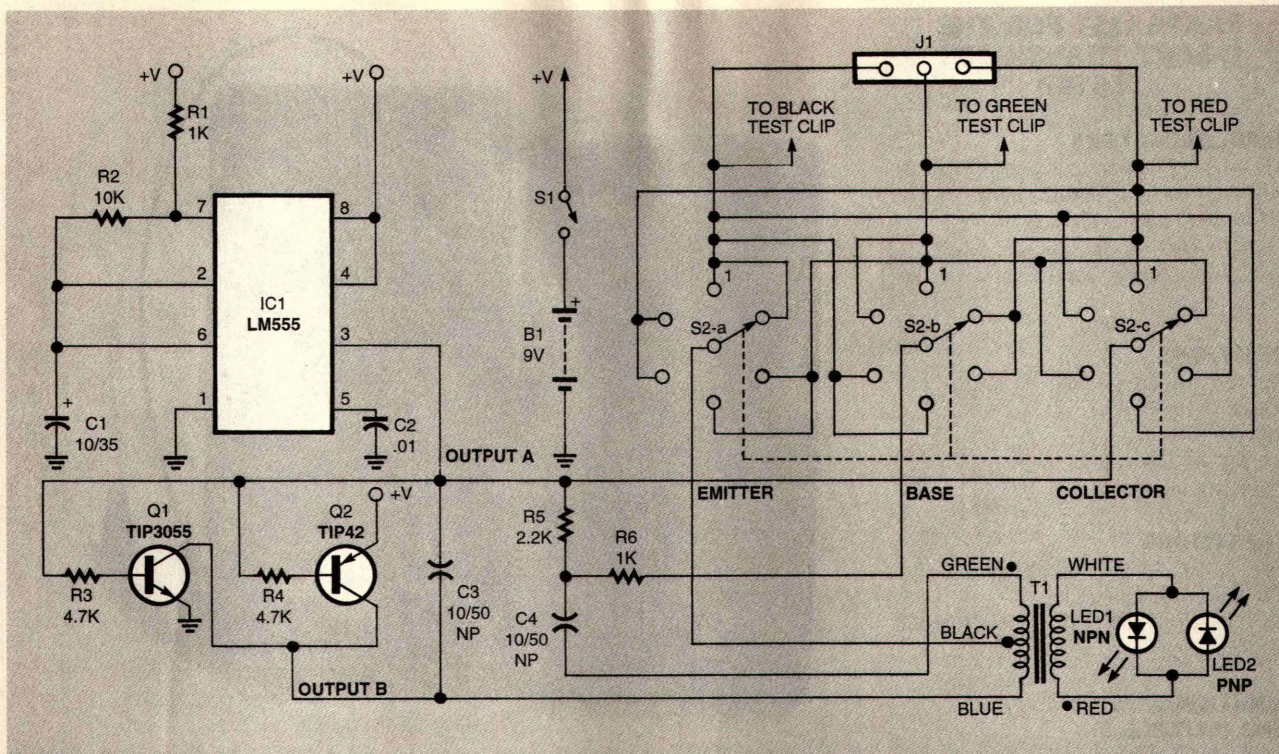


Fig. 1. The Q-Sort is a simple circuit with three sections: a switch, an oscillator, and a circuit that reverses the polarity of the oscillator's power supply ten times per second.

tions without having to physically rearrange the wires. The steering logic is handled by the complex interconnections among S2-a, S2-b, and S2-c.

Construction. The Q-Sort is simple enough to be built on a piece of perfboard using standard construction techniques. However, a single-sided PC board can also be used to help reduce wiring errors. If you'd like to use a PC board, a foil pattern has been included here. Alternately, an etched board is available from the source given in the Parts List.

If you use a purchased PC board or etch one using the provided foil pattern, the parts-placement diagram in Fig. 2 should be followed for component location. Before mounting the parts on the PC board, you might want to drill two additional holes for the mounting tabs of T1. Note that ordinary LEDs shouldn't be substituted for the high-brightness LEDs specified in the Parts List. Ordinary LEDs will result in poor performance at lower battery voltages, or possibly no performance at all.

The author's prototype was built

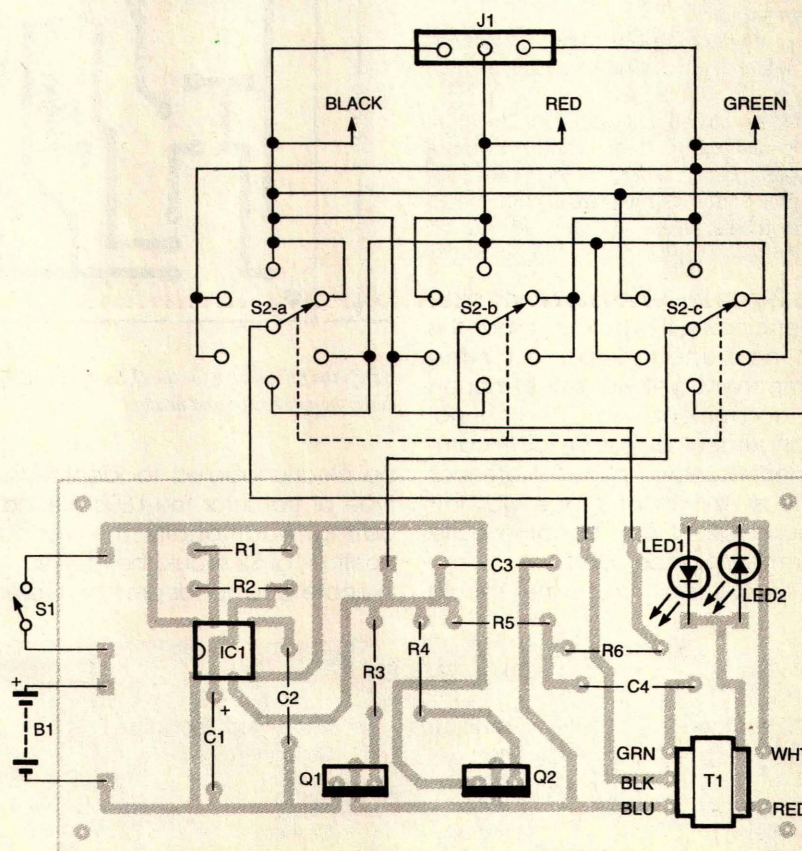


Fig. 2. Use this parts-placement diagram to assemble this fast, convenient, and inexpensive transistor tester/sorter for your test bench.

PARTS LIST FOR THE Q-SORT TRANSISTOR TESTER

SEMICONDUCTORS

IC1—LM555 timer, integrated circuit
Q1—TIP3055 NPN transistor
Q2—TIP42 PNP transistor
LED1, LED2—Light-emitting diodes, high-brightness (RadioShack 276-066 or similar)

RESISTORS

(All resistors are 1/4-watt, 5% units.)
R1, R6—1000-ohm
R2—10,000-ohm
R3, R4—4700-ohm
R5—2200-ohm

CAPACITORS

C1—10- μ F, 35-WVDC, electrolytic
C2—0.01- μ F, ceramic-disc
C3, C4—10- μ F, 50-WVDC, non-polarized electrolytic

ADDITIONAL PARTS AND MATERIALS

B1—Battery, 9-volt
J1—Header, three-pin
S1—Single-pole, single-throw switch
S2—3-pole, 6-position rotary switch
T1—Audio-output transformer 1000-ohm/8-ohm (RadioShack 273-1380 or similar)
Case, alligator clips, battery clip, battery holder, solder, wire, hardware, etc.

Note: An etched and drilled PC board is available from: Futuretech, PO Box 6291, Gulf Breeze, FL 32561 for \$12 plus \$3 for shipping and handling. FL residents, please add 7% sales tax.

in a 2-inch by 3-inch by 6-inch plastic enclosure. It was found that this size had enough space for the components yet was small enough for convenient use. The internal arrangement of the Q-Sort's components is shown in Fig. 3. Note that at least 1/4-inch of space was left around Q2—it can become quite warm during operation.

The Q-Sort's front panel should

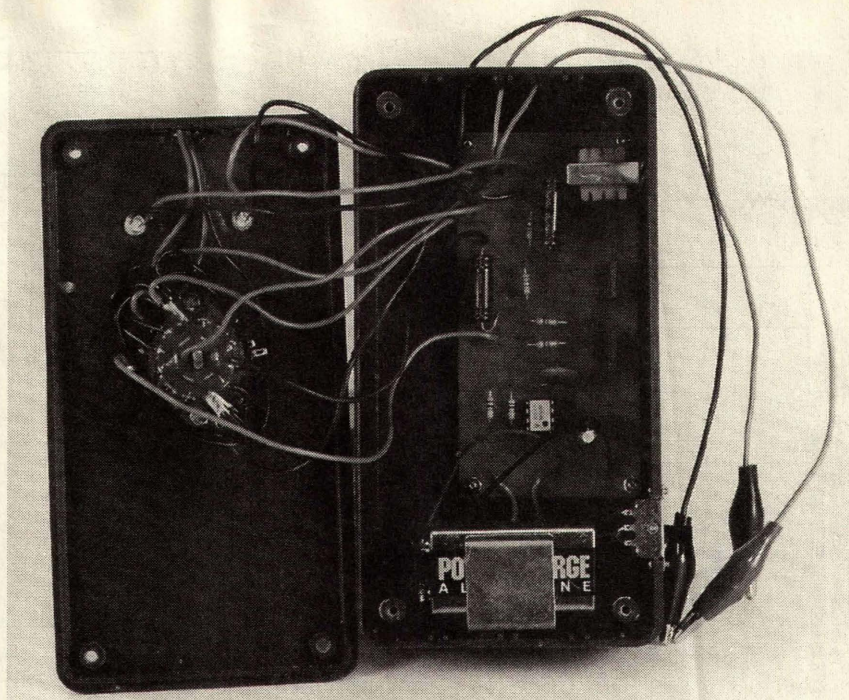
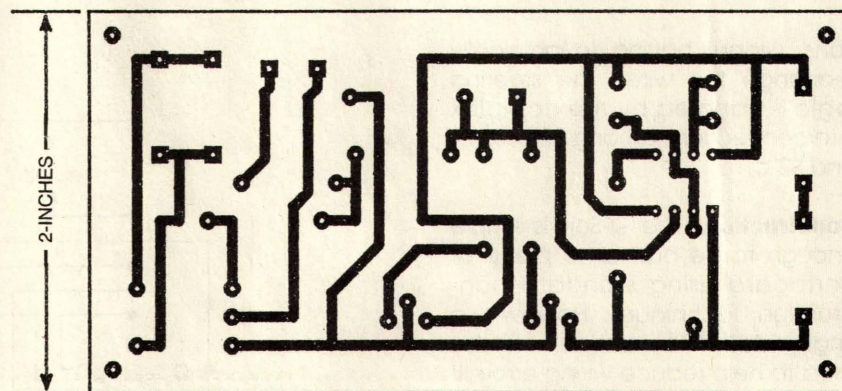


Fig. 3. Note that Q2 isn't crowded by other components and that the header is glued to the lip of the enclosure's cover for support.



Here's the foil pattern for the Q-Sort. Although a PC board is not required to build the Q-Sort, it will make the job easier and neater.

be clearly labeled to identify the type of transistor the LEDs are indicating. Additionally, the various positions of S2 should be marked to indicate what leads are connected

to which terminals on the transistor being tested.

Mount S2 centrally on the enclosure's front panel; S1 can be mounted on either the front or the side. Header J1 is mounted through a hole cut near the top edge of the front panel. Glue it in place with a suitable adhesive. Be careful not to get any adhesive inside the contacts of J1. Similarly, glue LED1 and LED2 in place in suitable holes.

We'll refer to S2's extreme counter-clockwise position (when viewed from the front) as the num

(continued on page 43)

TABLE 1

S2 Position	Transistor	Lead Configuration
1 Emitter	Base	Collector
2 Emitter	Collector	Base
3 Collector	Emitter	Base
4 Base	Emitter	Collector
5 Base	Collector	Emitter
6 Collector	Base	Emitter

IRIS RECOGNITION SYSTEMS

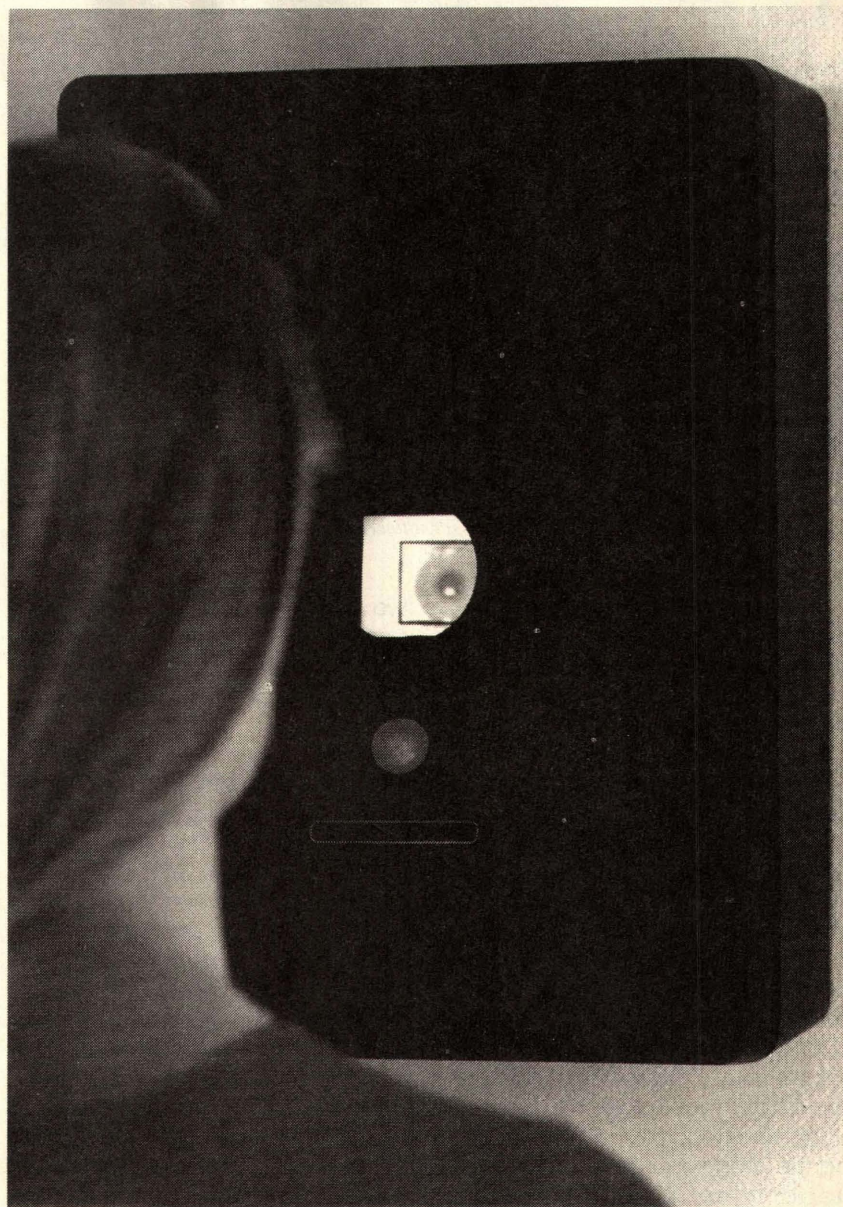
BILL SIURU

Each commuter quickly looks into a box containing a video camera and within seconds each passes through the turnstile and onto the subway train without using coins, tokens or tickets. A woman walks up to the ATM and then walks away, cash in hand, without using a card or entering a PIN. A man and his son go through the turnstile at the ballpark without a ticket. A woman looks into a camera to identify herself before she is issued a welfare check.

In each scenario above, the person's identity was verified using iris recognition, one of the techniques in the field of biometric recognition. Biometric recognition—the use of automated techniques for identifying individuals by their unique physical characteristics—is a rapidly growing industry around the world.

Fool-Proof Security. Much of the explosion in biometric identification is being driven by a growing concern for security in virtually every facet of life. It seems that as security technology gets more sophisticated, the bad guys get smarter. With color copiers, scanners, and printers, counterfeiters can produce IDs, concert and sports-event tickets and many other documents that cannot be told from the real McCoy. Other criminals use pilfered PINs at ATM machines, make purchases with stolen credit cards, gain access to secure buildings and computer databases, or collect entitlements like welfare and health care that they are not entitled to.

Biometric identification systems that prevent fraud and unauthorized access are now being used for everything from issuing driver's licenses to keeping track of inmates in prisons. They are replacing PINs at ATM machines, meal cards in university cafeterias, time clocks in the workplace, tokens on subways, tickets at sporting events, and even ensuring that only authorized persons pick up children from



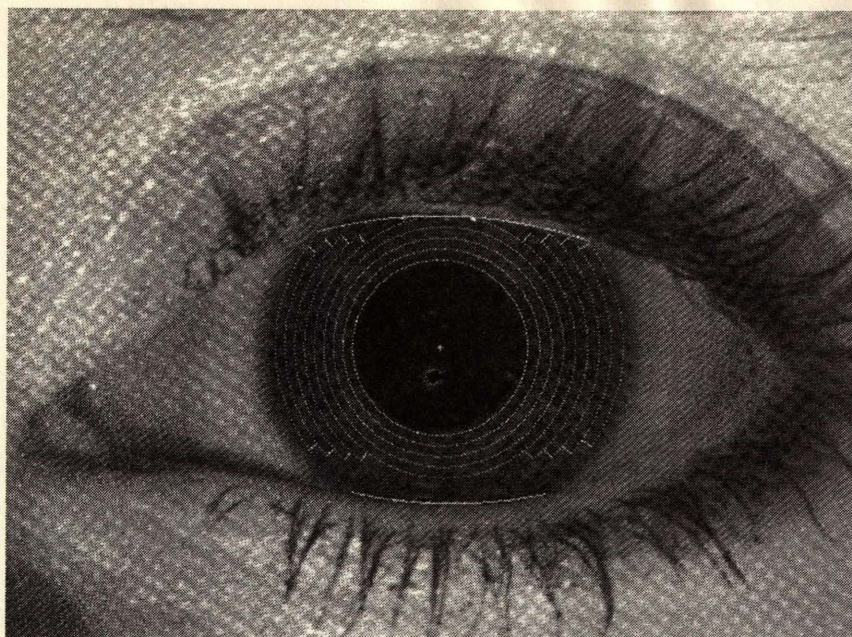
These fast, positive, easy, and non-intrusive systems put the "eye" in ID

daycare centers.

Fingerprints are the oldest and most widely used biometric identifier. Other physiological identifiers that can be used for positive identification include hand geometry, iris and retina patterns, and facial features. Biometric identification systems are difficult if not impossible to circumvent, even by the most cunning criminals. Unlike cards, the dishonest cannot steal or counterfeit

fingerprints, eyes, hands, or faces.

All biometric techniques include four basic steps. First, they capture the biometric characteristics during the enrollment process. Then unique features are extracted and converted into a mathematical code that is stored as a biometric template for a particular person. Templates can be stored in a computer database, on a smart card, or as a bar-code. Then when the person's identity



During the enrollment process, a video image of the iris is captured and the zones indicated here are analyzed and recorded to provide positive identification later.

is checked for recognition and verification, another biometric sample is taken and compared against the template. If the template and the new sample match, approval or access is granted.

So, then, why is a lot of attention being paid to iris and retina recognition? It is because both the eye's retina and iris are unique. As the eye develops, the blood-vessel pattern of the retina forms and does not change over a lifetime. Retinal recognition uses optics to map the capillary pattern of the eye's retina layer of blood vessels to produce a unique image. The primary application for this technology has been in high-security access control, including the most secure buildings at the Department of Energy, Cape Canaveral and other NASA facilities, the CIA, and FBI buildings.

However, iris recognition is even more promising, and for a wider range of applications. That's because less-sophisticated equipment is needed to implement an iris-recognition system.

Iris Recognition. The random patterns of the iris can be thought of as a complex human barcode that is created by a tangled meshwork of connective tissue and other visible features. Most important, for all the people on the face of the earth, no

two have identical irises, not even among identical twins. Nor do they change during a person's life or can they be altered by medical procedures.

IrisScan, Inc. in Mt. Laurel, NJ, has perfected the concept of iris recognition originally patented by two ophthalmologists, Drs. Leonard Flom and Aran Safir, in 1987. It is now marketing its IrisScan technology and equipment for a variety of biometric-identification applications.

One example is the IrisScan System 2100. Authorized individuals are "enrolled" (that is, their iris characteristics are recorded and entered into the system's database) by having them look into a camera lens so that a video image of the iris is recorded. The image is then digitized and processed into an IrisCode that is stored for future recognition. Both eyeglasses and contact lenses are accommodated easily, and the whole process takes about 30 seconds.

Then to gain access to restricted areas or information, or to make purchases, or for general identity verification, the enrolled individual looks into an IrisScan reader and, if the iris matches the valid IrisCode for that person, the identity is verified. Since the technique relies on the physiological response to light and natural pupillary oscillation, it cannot be

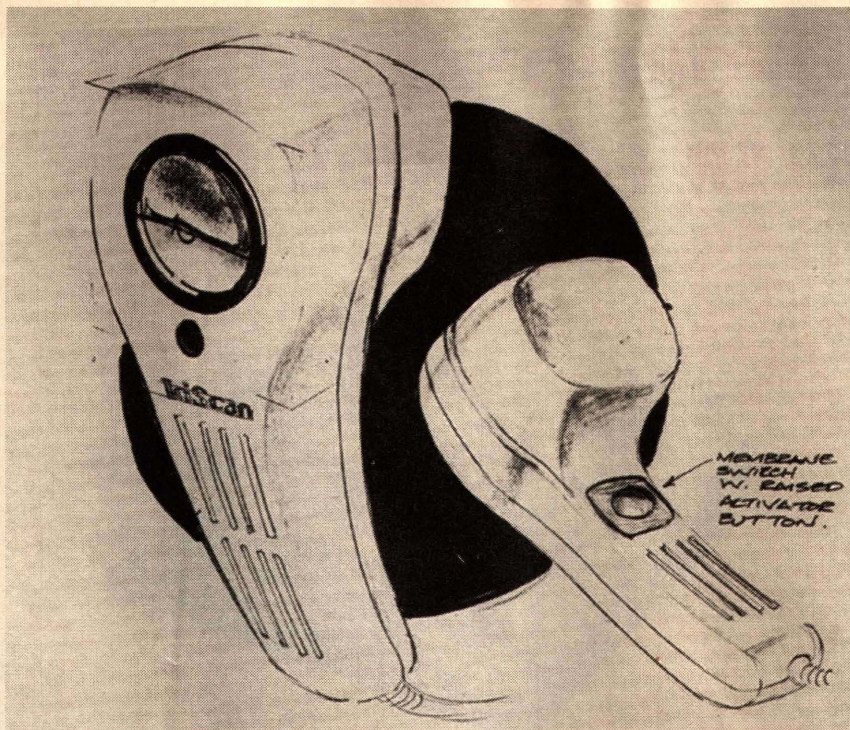
fooled by a photograph or another substitute for a real human eye. The recognition process takes only about 2 seconds, even with very large databases of IrisCodes.

For most databases of enrollees, the system will work with a reasonably capable PC running under NT 4.0. That PC can act as a central host computer and be connected to a network of several remote readers. In that way, a single system can be used for many access locations, though larger databases may need more storage capacity.

One of the first applications of the technology is for absolute identification of inmates in detention centers and correction facilities. The first system was installed at the Lancaster County Prison in Lancaster, PA in 1996, where all inmates are enrolled into the system to create an active file of current inmates and a historical record of previous residents. The latter provides early exposure of aliases should the same person return under a different name. Currently, the system is also being installed at the Sarasota County Detention Center in Sarasota, FL. There it is used to identify and confirm identities of inmates prior to being released from the facility for court appearances, work release, or at sentence completion.

As an added benefit, the inmates don't have to touch anything. They simply stand about one foot away from the camera and look into the lens for a few seconds. However, IrisScan requires a minimal amount of cooperation because the individual must look at a camera. Therefore it may not be appropriate for use where individuals may be uncooperative or incapacitated.

Other Applications. As important as the prison applications are, there are other areas where iris recognition could make a more significant impact in your life (at least we hope so!). For example, Spring Technologies in Falls Church, VA is using iris recognition technology licensed from IrisScan for its TranScan commuter-access system for subways and train stations. There, an automated biometric-identification system would eliminate the need to insert a card, pass, or token. In addi-



Here's an artist's concept of a portable system using the IriScan technology.



Among the possible applications, IriScan could be used to allow transactions at a bank ATM

tion to substantially reducing the costs of ticket production and collection, there will be a more orderly flow of traffic. Spring Technologies will introduce a TranScan prototype within the year, with a trial period slated to begin in one metropolitan city immediately thereafter. Seven of the country's largest mass transit agencies are being considered for possible testing sites. A portable system has also been

developed that could be used, for example, on buses.

Another application from Spring Technologies is SportScan, which would allow ticketless entry to sporting events at stadiums, arenas, and other venues. The system would use biometric information on spectators to debit or charge their accounts.

The American Red Cross is planning to use the IriScan to protect the nation's blood supply while maintaining privacy and anonymity, as well as to reduce time needed to fill out forms. Once a donor is registered, all of their information would be stored in the database and from then on, donations become a private procedure.

One of the most significant users of iris recognition technology could be the banking industry. Indeed, Oki Electric Industry Co., Ltd. in Japan is now field testing an access control system it developed for the Suruga Bank, Ltd. Other applications include credit-card transactions, e-commerce and Internet security, point-of-sale identification, and even horse identification.

Eventually, all IriScan system could be networked together. Therefore, once enrolled, for example, at your bank, the same IrisCode would be used for identification

and account debiting when using TranScan, SportScan, a credit card, an ATM, etc. Ω

THE Q-SORT

(continued from page 40)

ber one position. Wiring S2 can be confusing, but you can make the task more straightforward by soldering the appropriate wires to each pole's number one position all at once, rather than individually. That will save you from creating a piece-meal "bird's nest" of wires. Follow the wiring for S2 as shown in either Figs. 1 or 2. Black, green, and red test leads terminated with alligator clips are connected in parallel with the pins of J1 and are run through holes in either the side or front of the case.

Checkout and Use. To test the Q-Sort, you'll need both an NPN and a PNP transistor that are known to be good. Small signal transistors are best for testing J1, while larger power transistors can be used to check the test clips.

Turn the Q-Sort on and insert a transistor into J1. As you rotate S2, either LED1 or LED2, as appropriate, should come on when S2 is set to the position that correctly indicates the transistor leads. If the wrong LED or no LED lights, recheck your work. Most errors are usually found in the wiring of S2.

Since LED1 and LED2 are wired in inverse parallel, an incorrect indication usually means that one or both devices are installed backwards. For example, if both LEDs light up for one type of transistor but not for the other, the LED that lights up wrong is installed backwards. If both LEDs work but the wrong one lights up for both types of transistors, both devices are installed backwards. In that case, it might be easier to simply swap the LEDs in the front panel.

Using the Q-Sort couldn't be easier. Simply connect a BJT to either the Q-Sort's test leads or J1. Rotate S2 until either the NPN or the PNP LED blinks on. If neither LED comes on (and you've confirmed that the Q-Sort is working properly), the device under test is either defective or possibly not a BJT at all. Ω

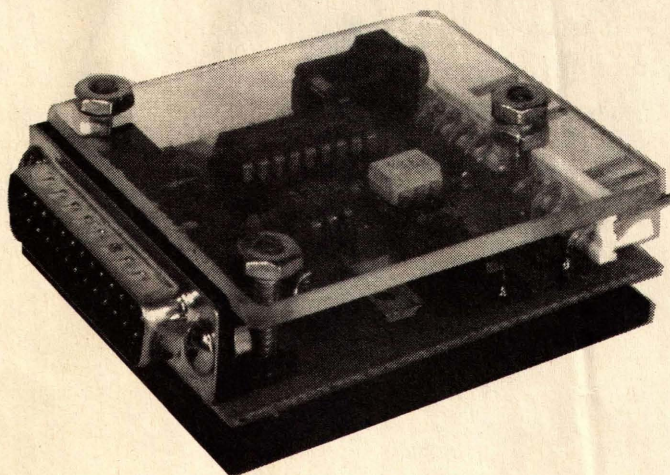
AN AC PROPORTIONAL VOLTAGE CONTROLLER FOR YOUR PC

NEIL BUNGARD

While it is easy to control appliances from a PC, that type of control usually has one of two conditions: on or off. There are many applications where it would be desirable to proportionally control the voltage level of an appliance that uses 110-volt AC service. Light dimming is one obvious application. Other uses include motor-speed control; heater control; and the ability to easily create an inexpensive, programmable DC power source.

In this article, we're going to show you how to use the parallel port of a PC, a few optical-coupling devices, and a Microchip PIC microcontroller to control the conduction angle of a 110-volt AC source, and hence to proportionally control a device connected to the PC's parallel port.

Controlling AC. Let's begin by looking at a 60-Hz 110-volt AC sine wave and talk about the concept of *conduction angle*. Figure 1A is the circuit that will be used for this discussion. We'll assume that S1 is an electronic switch that can be activated instantly at any time. If S1 is closed and remains closed, Fig. 1B would represent a single cycle of the signal that would be seen by load resistor R1. In that case, the load draws current during the entire cycle and would have a conduction angle of 360 degrees. In Fig. 1C, S1 does not close until the sinewave reaches 90 degrees in the cycle. As the signal passes through zero at 180 degrees, S1 is opened, stopping the flow of current to R1 for the next 90 degrees. At 270 degrees, S1 closes again and current once again flows through R1 until the zero crossing at 360 degrees. The signal in Fig. 1C has a conduction angle of 180 degrees. Since, in general, the conduction angle is the number of degrees that current passes through the load in



Use your PC to control appliance voltage levels.

each cycle, that means that the amount of current seen by R1 would be half the amount that would otherwise have passed through it.

In general, that is the way that an ordinary wall-mounted light dimmer works. The physical position of the light-dimmer knob sets the conduction angle at which conduction will begin after each zero crossing. Additionally, when the sinewave passes through zero, conduction is automatically stopped. Of course, that example controls the conduction angle mechanically. Such an arrangement is fine for open-loop control applications where you set the control once and leave it alone. For many control applications, however, you are not interested in just setting a conduction angle and letting the process run. You will want to monitor the process and dynamically adjust the conduction angle to keep the process operating at a preset level.

To dynamically control the conduction angle, you will need to know precisely what the angle is and be able to make adjustments accordingly. That is done by finding when the sinewave passes through zero volts. There are many circuits for

determining the zero-crossing point. If you need a high degree of precision, op-amps can be used to get within a few microvolts. Most applications, however, do not need that level of precision and a "quick and dirty" way of determining the zero-crossing point with a TTL-compatible output signal is to use an opto-coupler.

The opto-coupler circuit shown in Fig. 2A will work well but has some inherent shortcomings. Current-limiting resistor R1 must limit the forward current through the opto-coupler's diode and the external clamping diode to within the maximum limits for the devices at the peak voltage, which is about 156 volts when using wall current. The peak-inverse-voltage ratings of the diodes should also be at least 160 volts.

Another consideration is that the opto-coupler's output waveform will be non-symmetrical. That is because the input signal on the opto-coupler's diode must exceed the diode's forward-bias turn-on voltage before the diode conducts. That phenomenon has been exaggerated in Fig. 2B to illustrate the concept. Since the actual turn-on voltage is slightly above zero volts, the output will not have a perfect

50% duty cycle. Another problem that is related to the turn-on-voltage condition—and is much subtler—is that the diode's turn-on and turn-off voltages are not exactly the same. This principle, called *hysteresis*, is exhibited by most electronic components. It is especially noticeable in devices that monitor or control threshold activities such as zero crossing. The symmetry and hysteresis effects can be compensated for; we will see how to use software to compensate for those conditions later in this article.

Now that we are able to detect the zero-crossing portion of an AC cycle with a TTL output signal, how do we control the current to a load with a desired conduction angle? A general solution to that problem is shown in Fig. 3. A PIC microcontroller monitors both the zero-crossing signal from the opto-coupler and an 8-bit data byte from the PC's parallel port, which represents the desired conduction angle. By comparing the two pieces of input data, the PIC decides when to trigger the electronic switch. The electronic

switch we'll use in our controller circuit is actually a Triac that is triggered by the PIC. The sidebar, "Triacs, Diacs, and Control", explains the basics of how four-layer semiconductors are designed and used.

Using an 8-bit word to represent the desired conduction angle lets us control the conduction angle of the AC waveform in 256 discrete steps. That is probably more than enough resolution for most applications and appears continuous when being used in light-dimmer or heater-control applications. The sidebar, "The Parallel Port," reviews the operation of the PC parallel port and how it interfaces to the outside world.

Circuit Description. Bringing all of the concepts we've discussed so far together yields our project, called the Parallel-Port Controller. Its schematic drawing is shown in Fig. 4. Hardware operation for the entire circuit should be familiar based on the previous discussions.

Wall-socket current is applied to

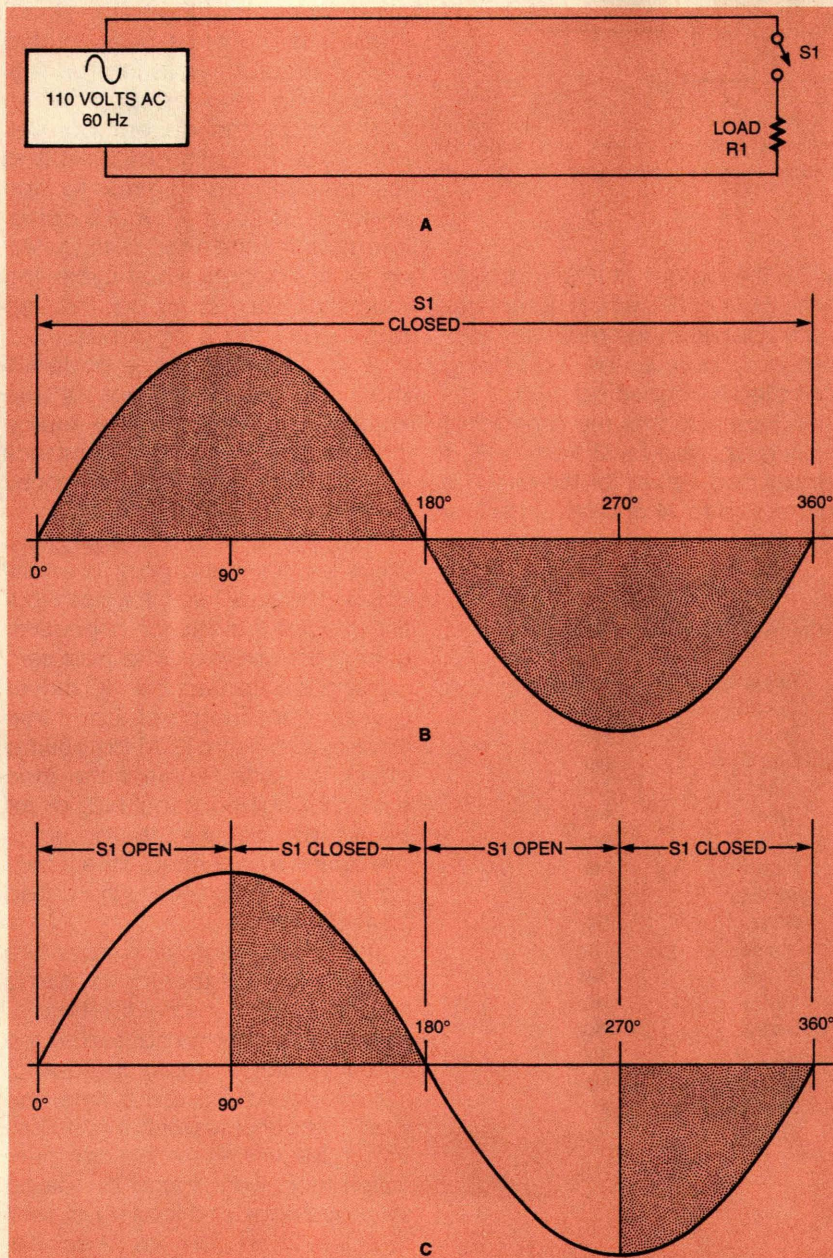


Fig. 1. Varying the AC current to a load is simply a matter of opening and closing a switch at the right time (A). If the switch is left closed for the entire cycle, the load will see full power (B). However, if the switch is opened and closed at the same points in the cycle, the apparent voltage applied to the load will be averaged out. In example (C), the load will only see 50% of full power.

PARTS LIST FOR THE PARALLEL-PORT CONTROLLER

SEMICONDUCTORS

- IC1—PIC16C54 microcontroller, integrated circuit
- IC2—H11AX optoisolator, transistor-based, integrated circuit
- IC3—MOC3010 optoisolator, Triac output, integrated circuit
- TR1—2N6347 Triac,
- D1—1N4004 silicon diode
- D2—1N5231 Zener diode

RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)

- R1, R5—100-ohm
- R2—1000-ohm
- R3—11,000-ohm, 1/2-watt
- R4—180-ohm

ADDITIONAL PARTS AND MATERIALS

- C1—0.01-μF capacitor, ceramic-disc
- J1, J2—4-pin right-angle connector (Molex 26-60-5040 or similar)
- J3—DB25 right-angle male connector (Mouser 152-3325 or similar)
- J4—Co-axial power connector, male (Mouser 161-3112 or similar)
- RES1—8-MHz ceramic resonator
- Wall transformer, Plexiglas covers, hardware, etc.

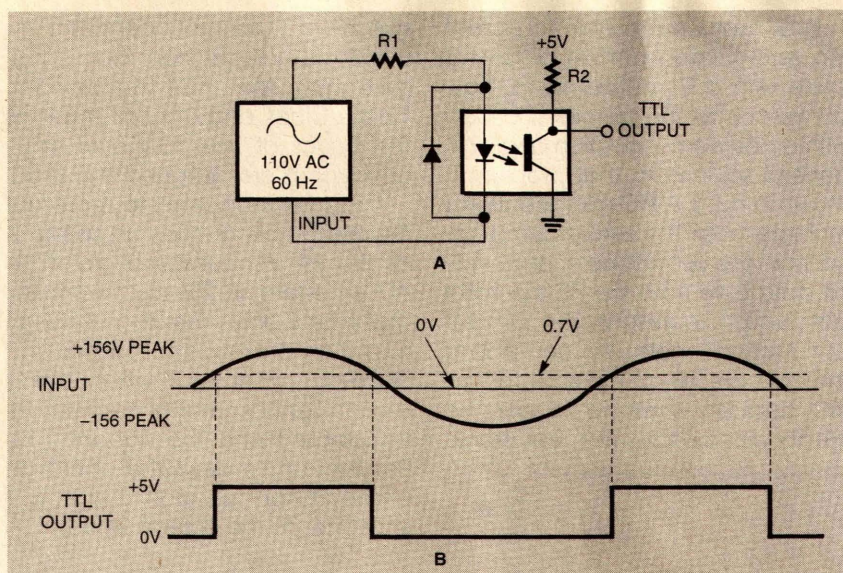


Fig. 2. It is very easy to sense the zero-crossing point of an AC cycle with a simple optoisolator circuit (A). Unfortunately, the digital output of such a circuit will not be a perfect squarewave because of the voltage drop across the internal photodiode (B).

J2. The AC waveform is applied to IC2 through R3 with D1 providing a reverse path as discussed before. The TTL squarewave is applied to pin 17 of IC1.

When the PIC program decides that the output should be turned on, an output signal from pin 18 of IC1 activates the photodiode of IC3. Current for the diode is supplied

by R1. The output of IC3 is applied to the gate of TR1, which completes a path between the main connections of J1 and J2. The load being controlled is connected to J1.

An 8-bit value for the amount of delay is applied to J3 from a PC's parallel port. Power for the circuit is connected to J4 and regulated by D2.

TABLE 1—
SPP MODE PHYSICAL AND LOGICAL PIN ASSIGNMENTS

Pin	Signal	In/Out	Register	Inverted
1	Strobe	In/Out	Control	Yes
2	Data 0	Out	Data	No
3	Data 1	Out	Data	No
4	Data 2	Out	Data	No
5	Data 3	Out	Data	No
6	Data 4	Out	Data	No
7	Data 5	Out	Data	No
8	Data 6	Out	Data	No
9	Data 7	Out	Data	No
10	Ack	In	Status	No
11	Busy	In	Status	Yes
12	Paper	Out / End In	Status	No
13	Select	In	Status	No
14	Auto Linefeed	In/Out	Control	Yes
15	Error/Fault	In	Status	No
16	Initialize	In/Out	Control	No
17	Select Printer	In/Out	Control	Yes
18	Ground	Gnd		
19	Ground	Gnd		
20	Ground	Gnd		
21	Ground	Gnd		
22	Ground	Gnd		
23	Ground	Gnd		
24	Ground	Gnd		
25	Ground	Gnd		

Software. Overall operation of the Parallel-Port Controller is really a function of the program running in IC1. Compensation for the non-symmetry and hysteresis problems mentioned before are accomplished by "tweaking" certain variables in the program.

The block diagram of the PIC program is shown in Fig. 5. After initializing the variables that the program uses, the PIC waits for a positive-going zero crossing to occur. At that time, a value from the parallel port is read and used to determine when to trigger the Triac. Once the Triac has been pulsed on, the program waits for the negative-going zero crossing. When that occurs, the current parallel-port value is again obtained and the precise turn-on time for the negative half of the cycle is calculated. Once the Triac is triggered on for the negative half cycle, the program loops back to the top and the process is repeated.

A study of the source code will show the inner workings of The Parallel-Port Controller. The source code is available at the Gernsback FTP site ([ftp.gernsback.com/pub/EN/ppc.txt](ftp://ftp.gernsback.com/pub/EN/ppc.txt)).

After initialization of the program variables, a starting point is established and the "wait_for_pos" routine begins looking for a positive-going zero crossing. When the zero crossing is detected, the PIC moves a value from the parallel port into the variable "temp1". At this point, a check is made to see if the Triac should be full on (temp1=0) or full off (temp1=255); if so, the appropriate action is performed, otherwise a call is made to a subroutine called "dwell".

The "dwell" subroutine does two things. First, it executes a timing loop that compensates for the premature zero crossing caused by the forward voltage drop of the detection diode. At the same time, the loop compensates for the hysteresis effect. The values for the compensation loop were found by testing several diodes and looking at their responses on an oscilloscope. Once an average time delay until the actual zero crossing occurs was found, compensation for the difference was done by manipulating

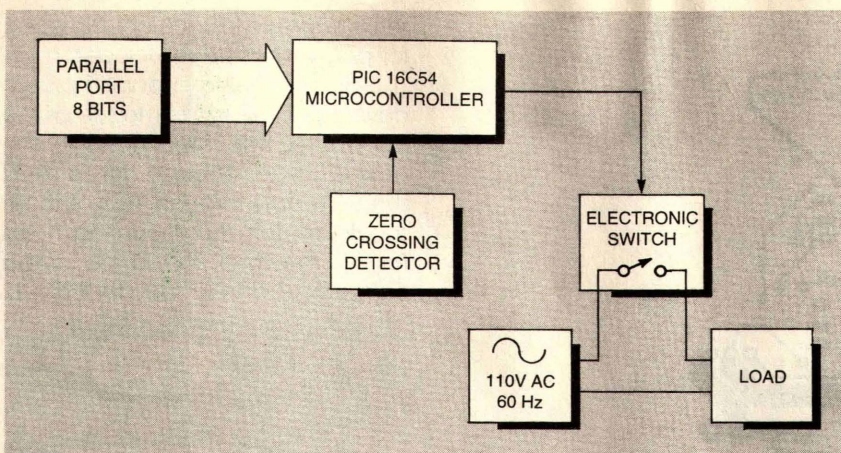


Fig. 3. Here's how to use a PIC 16C54 microcontroller to control the delay between the zero crossing of the AC cycle and switching on an output. An 8-bit number from the parallel port tells the PIC how long to wait.

the loop variables "await_cntr1" and "await_cntr2".

The second thing that dwell does is to use the value obtained from the parallel port in a second timing loop that decides when to turn on the Triac. The larger the parallel-port value, the longer the loop runs before it times out. A longer delay will fire the Triac later in the cycle resulting in less average current through the load.

When the second loop times out, program execution resumes at the "wait_for_pos" routine where the

Triac is actually turned on by clearing and setting RA.1. Once the Triac is turned on, the "wait_for_neg" loop looks for a negative-going zero crossing. When that condition is found, dwell1 is called again, using the parallel-port value to determine when to activate the Triac during the negative half cycle. Notice that compensation for the diode drop and the hysteresis is missing in the positive-going zero-crossing case. That is because the detection occurs *after* the actual zero crossing. Since it is very difficult to travel into the past,

the program code has been kept simple by ignoring that section of the waveform. The result is a small loss of control in terms of the entire cycle time. However, that presents no problem for most control applications. If that loss of precision is troublesome in your particular application, you can always replace the detection circuit (IC2) with an op-amp circuit to detect true zero crossing and regain the lost precision. Of course, sections of the program would have to be modified to ignore hysteresis and symmetry compensation; those types of modifications are beyond the scope of this article.

Construction. While the Parallel-Port Controller can be built on a perf-board using standard construction techniques, a PC board is recommended because of the high voltages involved. Any error in construction can damage equipment or

TRIACS, DIACS AND CONTROL

Both Triacs and diacs are four-layer semiconductor devices that can conduct current in either direction. The diac has two terminals. It is normally in an "off" state until a certain voltage level (the *breakover* voltage) is reached. At that point, the diac begins conducting current in the direction of the voltage polarity that is being applied across it.

The Triac, on the other hand, is like a diac with a third *gate* terminal. The Triac can be turned on by a pulse of gate current; there is no fixed breakover voltage needed. The breakover voltage in the Triac actually decreases with an increase in the gate current. The Triac can be thought of as two silicon-controlled rectifiers (SCRs) connected in inverse parallel with a common gate terminal. With that arrangement, the Triac can conduct current in either direction when it is triggered on. Like the diac, the current direction depends on the polarity of the voltage across the Triac's main terminals. Like the SCR, the Triac turns off when the anode current drops below a specified value, called the *holding current*. The only way to turn off a Triac is to reduce the anode current to a sufficiently low level.

Triacs are primarily used to control average power to a load by *phase control*. In that method, the Triac is not triggered until a certain amount of time after the zero-crossing point of an AC waveform for both the positive and negative portions of the cycle.

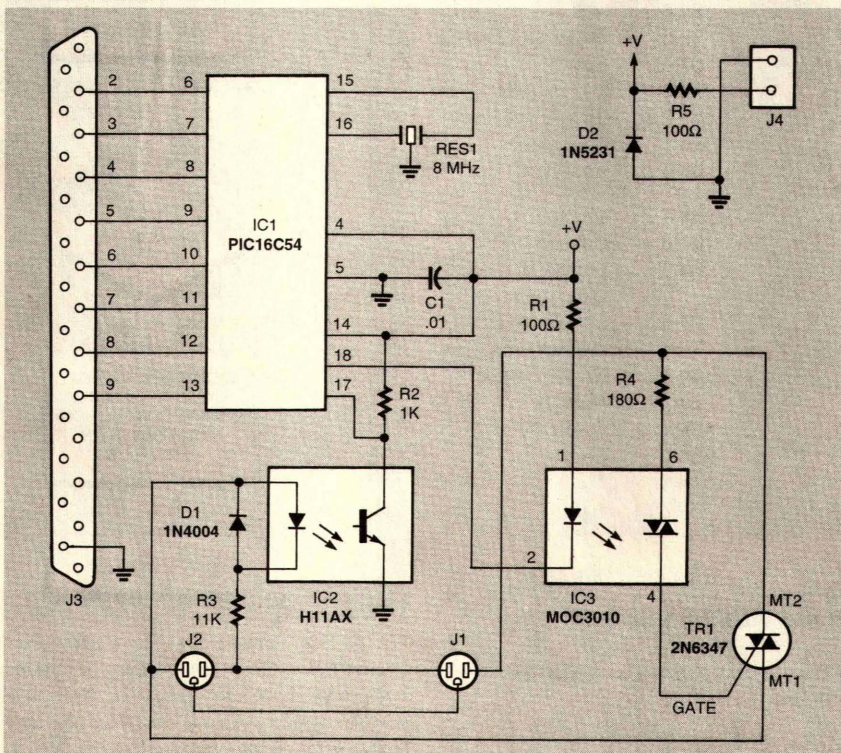
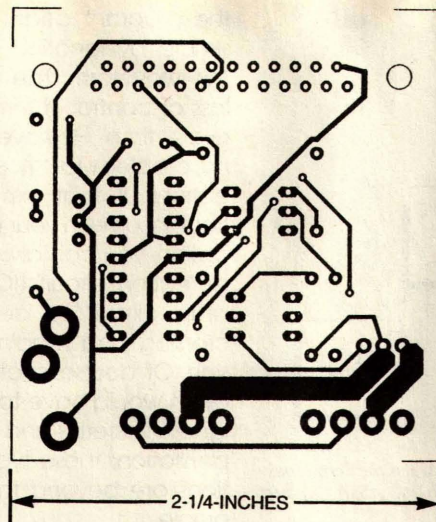


Fig. 4. The Parallel-Port Controller's schematic shows how simple the hardware is. Note that the output is also optoisolated by a Triac-output isolator.



Here's the foil pattern for the solder side of the Parallel-Port Controller.

TABLE 2—SOFTWARE REGISTERS

Offset	Name	Read/Write	Bit No.	Properties
Base +0	Data Port	Write (Read/Write if port is bidirectional)	Bit 7	<i>Data 7</i>
			Bit 6	<i>Data 6</i>
			Bit 5	<i>Data 5</i>
			Bit 4	<i>Data 4</i>
			Bit 3	<i>Data 3</i>
			Bit 2	<i>Data 2</i>
			Bit 1	<i>Data 1</i>
			Bit 0	<i>Data 0</i>
Base +1	Status Port	Read Only	Bit 7	<i>Busy</i>
			Bit 6	<i>Ack</i>
			Bit 5	<i>Paper Out/End</i>
			Bit 4	<i>Select</i>
			Bit 3	<i>Error/Fault</i>
			Bit 2	<i>IRQ (Active Low)</i>
			Bit 1	Reserved
			Bit 0	Reserved
Base +2	Control Port	Read/Write	Bit 7	Unused
			Bit 6	Unused
			Bit 5	Enable Bi-Directional Port
			Bit 4	Enable IRQ Via Ack Line
			Bit 3	<i>Select Printer</i>
			Bit 2	<i>Initialize</i>
			Bit 1	<i>Auto Linefeed</i>
			Bit 0	<i>Strobe</i>

Note: Italics indicates external signals

TABLE 3—
LOGICAL PARALLEL PORT ADDRESSES

Address	Notes:
3BCh - 3BFh	Used for Parallel Ports which were incorporated on to Video Card—Doesn't Support ECP Addresses
378h - 37Fh	Standard Address For LPT 1
278h - 27Fh	Standard Address For LPT 2
300h - 340h	Used for Prototype Board Development (64 individual Addresses)

result in severe injury. A double-sided foil pattern has been included here.

Start by cutting a pair of plastic covers that are the same size as the PC board. Drill three holes in the covers large enough for a 6-32 screw to pass through. Two of them should match the mounting holes for J3; the third should be drilled between J1 and J2 such that a 6-32

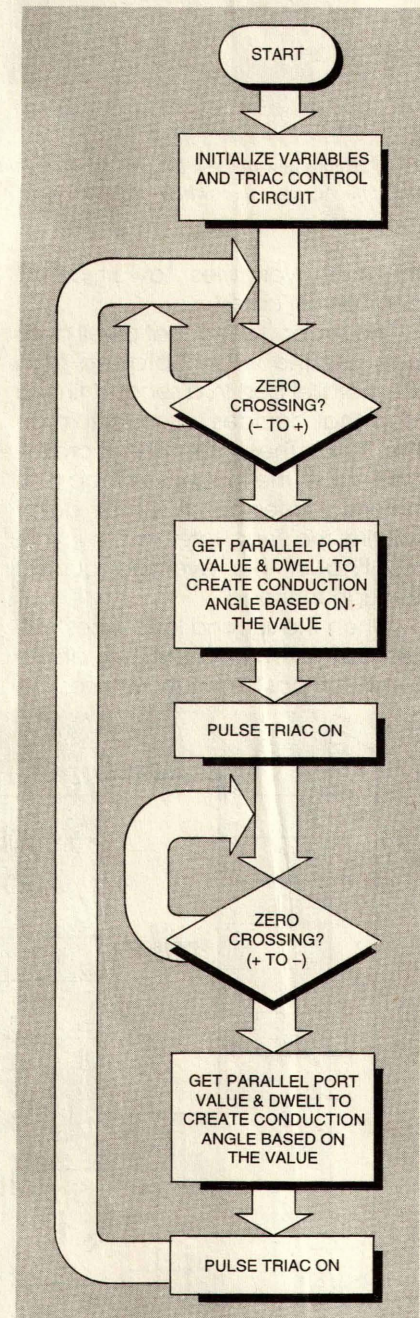
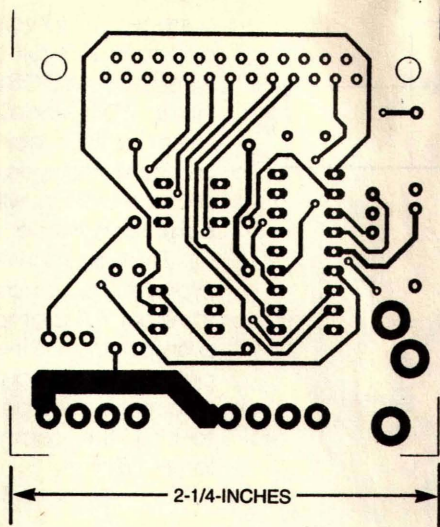


Fig. 5. The software for The Parallel-Port Controller is a simple loop that watches for the zero-crossing indicator, and calculates how long to wait before turning the Triac on. The calculation also takes the delay effects of the sensing circuit into account.



Here's the foil pattern for the component side of the Parallel-Port Controller.

THE PARALLEL PORT

Prior to 1994, the interface to parallel ports was not formally standardized other than the information released by IBM when the first PC came out in the early 1980s. That led to some frustration when trying to develop devices that could be used universally on different computers. In 1994, a formal standard, IEEE 1284-1994, was developed that defined the electrical, physical, and logical standards for the parallel port. That standardization eliminated many of the problems connected with designing hardware that could be used on any machine reliably. However, even today you will find hardware vendors that do not adhere to the IEEE 1284 standard—still making interfacing to a particular parallel port a process full of testing and guesswork.

The IEEE 1284-1994 Standard defines 5 modes of operation:

1. Compatibility Mode
2. Nibble Mode
3. Byte Mode
4. EPP (Enhanced Parallel Port) Mode
5. ECP (Extended Capabilities Port) Mode

The idea was to create a new standard that improved performance (speed and control) over the existing parallel-port specification, while at the same time maintaining backward comparability. The compatibility, nibble, and byte modes can use the original hardware without any redesigning needed; they are collectively referred to as the SPP (standard parallel port) mode. The EPP and ECP modes are improved performance modes that imply backward comparability with the earlier SPP standard.

The compatibility mode is also referred to as the "Centronics" (named after the printer manufacturer that devised the hardware connector and pinout specifications) mode and is a write-only specification. In that mode, data can be transferred from the computer to a device at a maximum rate of 150 bytes per second. The nibble and byte modes are used for read operations and transfer data from external devices to the computer at a speed similar to the compatibility mode. All three of those standards use software handshaking techniques, which is responsible for their relatively low transfer rates. The EPP and ECP modes rely on additional hardware that is used for handshaking. That means that fewer I/O instructions are needed to transfer the same amount of data—increasing the data-transfer rate up to about two megabyte per second. The ECP has the additional advantages of *direct-memory access* (DMA) capability, which eliminates the I/O bottleneck and gives the port direct access to the microprocessor bus. In addition, ECP mode utilizes *run-length-encoded* (RLE) data compression to improve the overall speed of data transfer.

The connector standard specified by IEEE 1284 will work physically with SPP-, EPP, and ECP-mode devices. However, the logical pin assignments are different for the three modes, and are backward compatible from the ECP mode. In other words, SPP-mode devices will work with SPP-, EPP-, and ECP-mode interface boards. The EPP-mode devices will work with both EPP- and ECP-mode interface boards, and the ECP-mode devices only work with ECP-mode interface boards.

nut will not touch any of the PC board traces.

Microcontroller IC1 will have to be programmed before installing it in the circuit. Note that object code has not been supplied—only source code. That source code will have to be "compiled" into the numbers that IC1 will recognize as machine-code instructions. While it is tempting to "tinker" with the program, it is a good idea to compile the original source code first. Once the Parallel-Port Controller is working, modifications will no doubt suggest themselves to the person who has the knowledge and ability to rewrite the program. Again, those topics are beyond the scope of this article.

Follow the parts-placement diagram in Fig. 6. Before mounting J1 and J2, it's a good idea to "key" the two connectors in order to prevent anyone from accidentally attaching the AC voltage source to the wrong connector. Clip the fourth pin from J1 and the third pin from J2.

An important consideration is that all of the components be below the height of J3. When mounting TR1, bend the leads over so that the component lies flat on the PC board. Sockets can be used for the integrated circuits; their use will not make the height of the components excessive as long as low-profile sockets are used.

The plastic shields are held in place with screws and nuts. Start by placing the screws through the shield that will protect the solder side of the PC board. Use nuts to tighten the screws in place. Next, place the PC board over the screws. Run another nut down the screw that is between J1 and J2. The height of the nut should match the height of J3. Place the upper shield over the screws and tighten it down with three additional nuts. The whole unit will become a solid assembly.

Testing. Checking the Parallel-Port Controller can be done without writing a single line of code by using the old MS-DOS utility DEBUG. That programming utility still exists in today's operating systems; it can be found in the WINDOWS\COMMAND folder under Windows 95 or Windows 98.

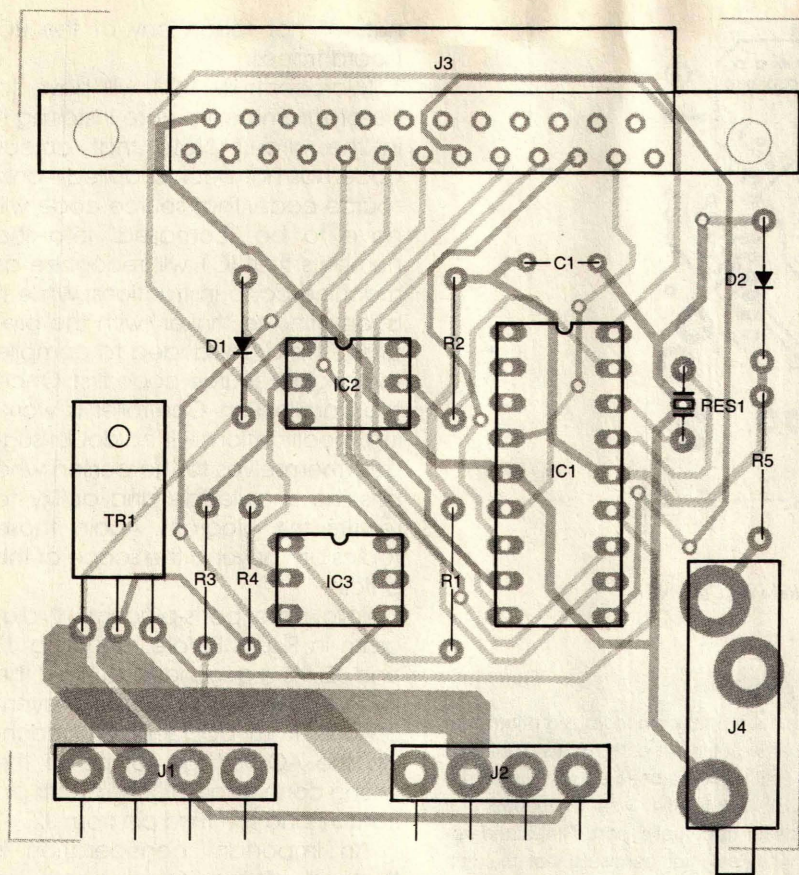


Fig. 6. The Parallel-Port Controller is a very simple device to build, thanks to the use of a pre-programmed microcontroller.

To test the Parallel-Port Controller, plug the controller directly into the PC's parallel port (LPT1) or use a 25-pin extension cable between the controller and the PC. Using an extension cable has the advantage

of making the controller more accessible, which can be a big help if any troubleshooting is needed.

Connect a common lamp to J1; be sure that the lamp switch is on and that the bulb is good. Carefully

connect a 110-volt AC cable to J2 and to a 110-volt outlet. Start DEBUG by going to a DOS prompt (or opening a DOS window). Change to a directory that contains the debug program and type DEBUG at the DOS prompt. Debug will respond to the command with a prompt of its own (-). That is known as the *debug prompt* (as opposed to the more familiar DOS prompt). At the debug prompt, you will type a simple output port command to send hexadecimal values between 00 and FF to LPT1. The command to turn the lamp full on is:

o 378,0

To turn the lamp full off again is:

o 378,ff

The command starts with the letter "o" followed by a space and the address of the printer port. If you are using LPT1, the address is 378; for LPT2, it is 278. Separate the data from the address with a comma. Any number between 00 and ff (hex) in the output port command will vary the intensity of the lamp between full on and full off. Try several values; remember that the higher the value, the dimmer the lamp.

With the Parallel-Port Controller working, you can now control the world from your desktop...or at least a few handy appliances! Ω

THE REAL McTUBE

(continued from page 35)

McTube will make it easier to get consistent sounds, but will also greatly affect the change of sound with varying dynamics. If you have multiple effects, experiment with the various combinations. Where you place The Real McTube in your chain of effects will have a lot to do with the final sound.

Modifying the Real McTube. You might want to reduce the values of coupling capacitors C6 and C8. If you examine the waveform with an oscilloscope, you can see that those components will have a considerable effect on the exact nature of the transients that occur during clip-

ping distortion. Lower values will give a reedier quality, the higher values as shown in the schematic result in a fatter sound. Try removing C7. You'll have less gain, but see how much cleaner the tube sounds? If you didn't know better, you might even think that it's an op-amp stage. Short the cathode directly to ground—see how much dirtier the sound gets as the grid is driven into conduction?

The circuit is extremely forgiving. Feel free to experiment with the values of the various components. Use the values shown as a starting point, and experiment. As a word of caution, however, it is a good idea not to use a value for R4 and R6 lower than about 22,000 ohms. That will prevent possible damage to the tube or power supply.

Take the opportunity to experience the fascinating, frustrating, flexible and highly subjective world of the vacuum tube amplifier! Ω



"On Line? I'm not even on desk yet!"

Affordable Hi-Tech Training!

Announcing New Micro Courses from the CIE Bookstore.



Easy at-home learning.

Cleveland Institute of Electronics has created a collection of micro courses that focus on our most popular subjects.

Offered through our bookstore, every micro course leads to a Certificate of Completion once finished. Each course may contain up to 39 lessons with exams and many have lab exercises, training videos or software to supplement your studies. Experience a step-by-step program designed specifically for the independent study student.

Enroll now and receive student privileges that include **Instructor Assistance***, **Priority Grading and Student Resources**. These privileges will allow you to access our faculty and staff if you ever need assistance with your course work and insure that your submitted exams will be graded and sent back to you within 24 hours.



Programmable Controllers Micro Course

This course starts by explaining how a Programmable Controller (PLC) functions in an automated system. Learn about the parts of a PLC which enable it to perform its function. Look at a typical application and learn how to develop a written program for it.

01-PC01.....\$65

(This micro course would make a great addition to the videos listed below. 01-567PLC)

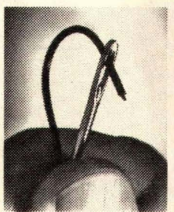
8-Part PLC Video Training Set

Contains 4 hours of video lessons and a 146 page study guide. These easy-to-follow video lessons will make learning this vital information fast & easy. This 8-part training course is designed to take 32 hours.

However, you can study at your own pace & review each lesson as many times as you need! Video set does not include certificate of completion. 01-567PLC **\$180.00**

Subjects Covered In the Video Training Set:

- How process control works
- PLC advantages
- PLC disadvantages
- Identifying PLC sections
- Move functions
- How to read flow charts
- Troubleshooting techniques
- Identify logic faults
- PLC servo control
- Scanning sequence
- Timer instructions
- Counter instructions
- Output instructions
- Identify input faults
- Identify output faults
- * Plus much more!



Fiber Optics Course

Apply what you have learned in this course to install, diagnose and repair complex fiber-optic communications systems and take your place in the forefront of a

fascinating and challenging new technology.

CIE Lesson & Exam Material Covers:

- Troubleshooting Fiber Optics • Characteristics of Fiber Optics • Fiber-Optic Communications Modules • Light • Laser Atomic Physics
- Practical Lasers • Modulating the Laser Beam • Masters • Laser Applications
- Maintenance of Lasers & Laser Systems

Video & Workbook Material:

- Understanding Fiber Optics
- 01-FB01 **\$125**



AC/DC Basic Electronics with Lab

39 lessons with lab. All this knowledge & support will put you on the road to understanding many areas of electronics.

03-INTRO **\$195**

CIE Soldering Course with Lab

3 lessons with lab, soldering iron & video tape.

01-SD01 **\$95**

Television Diagnosis & Repair Course

12 lessons, 5 videos & technician repair software.

01-TV01 **\$345**

Computer Programming in C

10 lessons, text, study guide & software package

04-CET352 **\$275**

Database Management

6 lessons, dBASE III software (student version)

01-DB01 **\$195**

Computer Aided Circuit Design & Drafting with Lab

16 lab assignments, Micro-Cap III (student version) 04-CET351 **\$195**

Introduction to Computers

8 lessons on the basics, video. 01-IN01 .. **\$195**

Automotive Electricity & Electronics Course

5 lessons, 150 piece Auto Electrical Tool Kit

01-AU01 **\$195**



Oscilloscope Fundamentals

Learn fundamental principles common to all oscilloscopes.

1 lesson, video and workbook. 01-SCP01...**\$95**



Microprocessor Theory & Applications

Learn operation & architecture of a microprocessor. Program in machine and assembly language. 17 lessons, lab & video. 03-MICRO .. **\$475**

FCC Exam Review Course

25 lessons to prepare you for general-class license. FCC ID software. 01-FCC01 **\$295**

CET Exam Review Course

1 lesson to prepare you for Associate-Level CET test. Answer practice test questions that will cover all areas of the test. 01-CT01 **\$65**

*Some courses include non-CIE material (videos) that will supplement your studies but will not be included under Instructor Assistance.

Start your training today!



Call: 1-800-321-2155

or fax: 1-440-951-2186

Send check, money order or credit card information to: CIE 1776 E. 17th Street Cleveland, OH 44114 or call 1-800-321-2155.

Name _____

Street _____

City _____

State _____ Zip _____

Phone Number _____

Enter Micro Course Number and Price.

OH RESIDENTS ADD 7 %	
SHIPPING & HANDLING**	
TOTAL	

_____ VISA _____ MasterCard _____ Discover

Exp. Date _____

Account Number _____

Signature _____ Date _____

SHIPPING & HANDLING CHARGES:

\$50.01- \$100.....\$10.25 \$200.01- \$400.....\$25.75
\$100.01- \$200...\$15.75 \$400.01- Over....\$31.00

** Foreign shipping costs will be higher.
Call for rates.

MC04

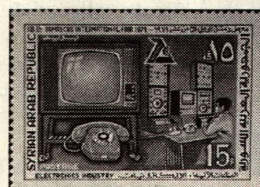
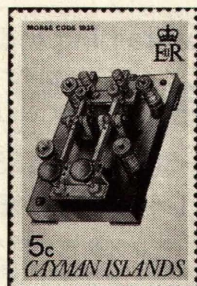
February 1999, Electronics Now

51

Call 1-800-321-2155 or fax 1-440-951-2186 to place an order. CIE: 1776 E. 17th Street, Cleveland, Ohio 44114. www.cie-wc.edu



A STAMP OF APPROVAL



Ever since England issued the first postage stamp over 150 years ago, postmaster generals from around the globe have commemorated the great events and people of history in stamps. Those accorded such a distinction have a permanent niche in world history. In fact, stamps have become such a depository of historical data that, if archaeologists from some future civilization excavated a 20th-century stamp collection, they would be able to deduce from it the importance of an individual or an event in our society.

Therefore, considering the important role radio has played in world events and how dramatically the technology has altered civilization over the past century, it is hardly surprising that you can find a detailed pictorial history of radio in the postage stamps of the world.

The history of the world can be seen through postage stamps, and that includes nearly every significant event and individual involved in radio.

JAMES E. BIE and
RAYMOND SCHUESSLER

A Who's Who of Radio. The individuals and advances that have marked the history of radio certainly deserve such an accolade, and the contributors to the phenomenon read like a Who's Who of Great Scientists. Stamps have been issued to commemorate Hertz, Armstrong, Branly, Fessenden, and more (see Fig. 1).

Even the question of who invented radio is "debated" in stamps. Guglielmo Marconi, pictured on a Radio Centennial stamp issued in Ireland and shown in Fig. 2, is credited by many with the invention of

radio. However, that claim does not go unchallenged.

Russia has always stood firm in its claim that Aleksandr Popov invented radio. They issued stamps honoring his accomplishments in 1925, 1927, 1945, 1949, 1955, 1959, and a new centennial stamp in 1995. On the colorful example from 1989 shown in Fig. 3, Popov is seen demonstrating his wireless transmission device to government and academic dignitaries at the University of St. Petersburg.

Radio in Times of Trouble. While stamps are used to celebrate humanity's achievements, they can also be used to serve as a reminder of our darkest hours. For example, three stamps in Fig. 4, from South Africa, Germany, and the Soviet Union, illustrate a variety of war-time radio operations. Radio's use in international crime fighting is illustrated



Fig. 1. Stamps often commemorate the great individuals and their achievements. Shown here are stamps that honor Hertz, Armstrong, Branly, and Fessenden.

on a 1973 Austrian stamp that shows a grim-faced Interpol operator (see Fig. 5).

Radio can play a key role in life saving operations. The stamp in Fig. 6 shows an ambulance driver radioing information to a hospital. The stamp was issued in Grenada as part of the 1983 World Communications Year.

Combining Your Hobbies. In a short article like this, we can only touch on some of the hundreds of radio-related stamps issued by the many countries of the World. If we've whetted your interest, the rest is up to you. There are many ways to learn more and perhaps gain a second hobby.



Fig. 2. Italian Guglielmo Marconi, shown here on an Irish stamp, is credited by most with the invention of radio.

The best place to start might be your local library. There you can peruse the *Scott Catalog of Stamps*, which lists and often illustrates all the stamps of the world ever issued. The catalog is revised annually to include all new stamps and price changes. Jot down the call number for the stamps you are interested in for later reference.

While at the library, you might want to look at issues of a stamp newspaper such as *Linn's Stamp News* (P.O. Box 29, Sidney, OH 45365; Web: www.linns.com) and find dealers who specialize in the countries whose stamps you need. These papers also contain data on all new stamps being planned and those just released.



Fig. 3. Marconi's claim is challenged by the supporters of Aleksandr Popov, shown demonstrating his radio apparatus in this stamp issued in 1989 by the former Soviet Union.

You also should visit a local stamp shop. By seeing first-hand all there is to see, you will begin to appreciate the infinite variety of stamps, the prices involved, and the equipment available to accommodate your collection.

Stamp collecting is twice as much fun when you can talk and swap stamps with other collectors. The best way to start is to join a local stamp club. Most stamp clubs will make you a welcome visitor. Sit in on a few meetings. See it all for yourself and get reliable information from these experts. You can



Fig. 4. As commemorated by these stamps, radio is a vital part of wartime operations.



Fig. 5. This Austrian stamp illustrates radio's use in the hunt for international criminals.

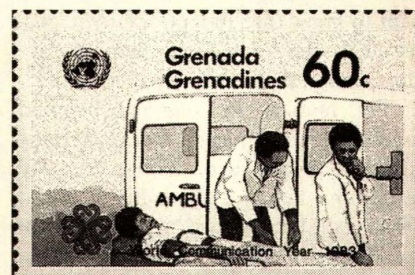


Fig. 6. Radio can play a key role in life saving operations, as shown in this stamp issued by Grenada.

find information on local stamp clubs from your town newspaper or you local stamp shop.

Stamps are a great way to learn about history, appreciate art, or just have fun. And while you might think that the worlds of radio and stamp collecting are as far removed as can be, as we've just shown, nothing could be further from the truth.

Measuring Luminosity, Hydrogen Absurdities Exposed, and A Remote Control For Your Cat

WE SEEM TO HAVE A WILD MIX OF TOPICS THIS MONTH, SO LET US JUST JUMP RIGHT IN. WE MIGHT START OUR QUEST BY LOOKING AT . . .

Visual Luminosity

Light is electromagnetic radiation at incredibly high frequencies. It occupies just under an octave's bandwidth, ranging from high-frequency blue, which has a wavelength of around 400 nanometers, to low-frequency red, which has a wavelength of somewhat under 700 nanometers.

Things get real sticky in a hurry when you try to measure light. Do you, as an astronomer, want to know the exact amount of energy received? If so, you should be interested in the brightness of a source. If, instead, as an architect, you'll want to know the amount of energy perceived by the human eye, then you are interested in the luminosity of a source.

The human eye long ago adapted itself to center its response on solar radiation, combined with foliage and sky reflections. Figure 1 shows the Standard Observer Luminosity Curve, otherwise known as the "standard eyeball". We see that the eye is best at seeing green and poorer at red and blue, tapering off to zero at the visual band limits. Crudely, it takes five or so parts of blue or two parts of red to equal one part of green. Here is a more specific (but rather phosphor-dependent) formula used by PostScript and NTSC TV:

$\text{gray} = 0.60 \text{ green} + 0.29 \text{ red} + 0.11 \text{ blue}$

A luminosity-measuring scheme is shown in Fig. 2. You focus upon the intended surface or source and then run

through a special calibrated filter that converts "raw" broadband sensor response into the desired CIE response. Calibration curves are carefully provided for each sensor.

The Tektronix J6523 narrow-angle luminance probe is a good example of the instruments used for this application. It can be used with their J-16 digital photometer, or else can be adapted to most any DVM or data acquisition system. More information on this potent instrument front end appears at www.tinaja.com/bargte01.html, and more information on getting colors to print properly as grays is found at www.tinaja.com/acrob01.html

Shattering Some Hydrogen Myths

There's some outrageous postings knocking around the Web these days. Of course, I feel I must comment on some of them. Two involve hydrogen energy, so let's take a closer look.

The first claim is that if you ignite a stoichiometric mixture of hydrogen and

oxygen, instead of exploding, an "implosion" occurs and a vacuum of sixty three inches of mercury results! Well, a vacuum is simply nothing. There's no known way to get less than nothing. Yes, you might be able to owe money but no way is known to owe mass.

Package a one-square-inch column of all the air directly above you and weigh it under earth gravity. You'll find it measures something like 14.7 pounds, which is equal to around 39 inches of mercury or 32 feet of water.

Now, empty a solid box, creating a "fairly good" vacuum. The resulting pressure will be 14.7 psi. Now build a "darn good" vacuum. How does the pressure on the box change? So little that you'll barely notice!

Next, build up a "perfect" vacuum. Your pressure will change even less. Since you can't get less than nothing, no way can you get a vacuum better than 39 inches of mercury.

For similar reasons, the ultimate limit on a lift pump or a drafting fire engine is 32 feet at sea level. But in practice, 24 feet is the best you will usually be able to do. You can't suck out something that is not there!

Wait—it gets even worse. Put some water in your reduced pressure box. A fraction of your liquid water should rapidly convert to vapor. Figure 3 shows you how the vapor pressure of water varies with temperature. Somewhat above room temperature, the vapor pressure of water is around one pound per square inch.

Thus, there is no way to create a vacuum of less than one psi in any box that still contains warm liquid water! That's especially true if the only activity creating the reduced pressure in the first place is water condensation.

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US email: don@tinaja.com
Web page: <http://www.tinaja.com>

What about the implosion part? What usually happens is a normal explosion sometimes followed up by condensation of the vapor into liquid water. Yes, the final pressure can end up less than atmospheric. But if you repeat this experiment several times, things will warm up, and this curious reduced pressure disappears. Above the boiling point of water, you will usually get an explosion only.

This sometimes reduced pressure can create severe safety problems, especially when an unarrested flame gets sucked back into a tank, hoses, or an electrolyzer. One "free energy" proponent recently and dramatically verified this experiment.

Much more on amateur vacuum techniques is in Steve Hansen's Bell Jar and at his supporting Web site, www.tiac.net/users/shansen/belljar

Another outrageous claim is that it is simple, cheap, and easy for solar electricity to generate hydrogen. Yes, solar cells output low voltage DC, electrolysis needs low voltage DC, and hydrogen storage nicely averages out day and night. So the two eventually should provide an interesting match. We saw how the NREL paper in *Science* for April 17, 1998, pp. 425-427 doubled the usual solar-to-H₂ efficiency in a direct conversion process, but still using only uneconomic materials.

Sadly, generating hydrogen is not the problem. There's much better and cheap-

er ways to make hydrogen that do not use water electrolysis. Your key unsolved problems are dense and efficient storage, user-safety issues, and long-life engines or cost-effective fuel cells. Nonetheless, let us run a quick reality check:

Say you have a large 400-watt solar panel? How much hydrogen can you generate how fast? Well there's 9600 watt-hours per liter in gasoline, and 3.5 watt-hours energy per liter in STP hydrogen. Allowing for inefficiency, figure around 15 kilowatt hours off the panel for the hydrogen equivalent of one liter of gasoline, or well over one week per hydrogen equivalent gallon of gas—weather permitting!

The key problem here is that solar energy is very diffuse and inefficient. Hydrogen energy is also diffuse and inefficient. Combining them using today's tools only makes things much worse. Today, solar electrical energy is much too valuable to waste on water electrolysis, but keep on trying, anyway. More hydrogen tutorials and links can be found at www.tinaja.com/h2gas01.html

I Taut I Taw A Puddy Tat

The Catfinder from Curtis Electro Devices is a cute new variation on mid-range remote controls. You have a small four-channel UHF handheld transmitter and up to four miniature beeping

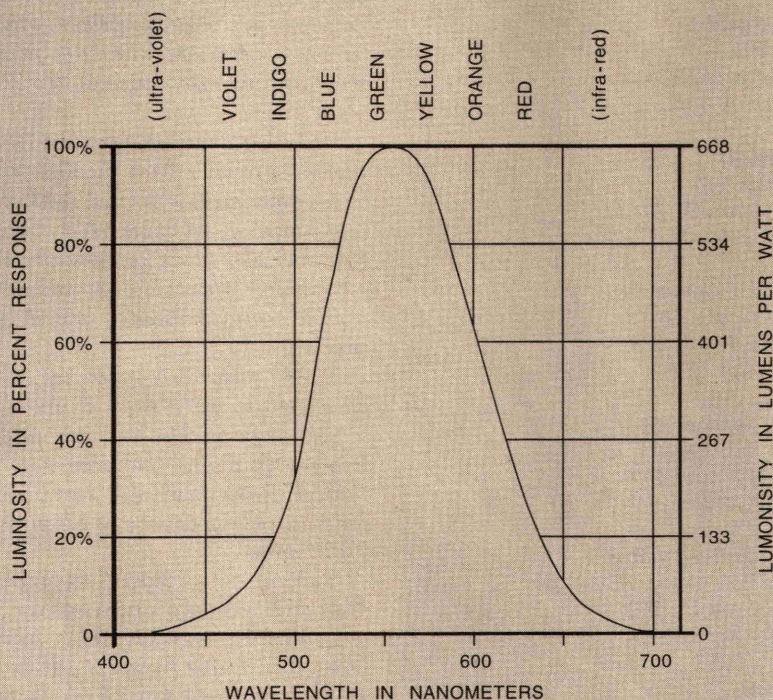


FIG. 1—THIS STANDARD LUMINOSITY CURVE shows how human perception of light intensity varies with color and frequency.

new from DON LANCASTER

ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **\$28.50**

RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. **\$79.00**

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. **\$28.50** each.

INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **\$18.50**

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **\$119.50**

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **\$39.50**

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. **28.50**

BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **\$24.50**

RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **\$24.50**

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: don@tinaja.com
FREE US VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

FREE catalog: <http://www.tinaja.com>

receivers. By attaching the receiver to the cat's collar, you can find Percival Pussival whenever it is time for his bath or a trip to the vet. There's also an 800 tracking number and registration should your cat get stolen, lost, or wander off.

The unit is also useful for people who continuously lose stuff, such as remote controls. You simply attach a receiver onto your TV remote and it beeps when you press the Catfinder controller. There's also potential here for wandering grandmothers, smaller children, or disability aides.

The price is \$29 for the controller

and one receiver, plus \$15 for each extra receiver. Receivers are programmed to a particular channel during power up. You hold the selected transmitter button down while you insert the battery into the receiver. The receiver double beeps when programming is complete. The claimed range is fifty to seventy feet, which would cover nearly half an acre. But my own tests did not deliver nearly that range.

I did not look too close, but the circuitry probably works in the typical 350-MHz remote control band. The receivers are superregenerative, or possibly some-

thing newer and better, such as time-gated TRF.

The latest versions are now newly waterproofed. Seems the cats quickly discovered that they could defeat the Catfinder by soaking it in their water dish. The issues of finding the cat to install the Catfinder or losing your Catfinder remote have not been addressed.

Catfinder Contest

The Catfinder folks have agreed to a special contest just for readers of this column. Just tell them something unique or unusual you would like to do with one or more Catfinders. They will promptly award a dozen or more free systems to the best entrants.

There's some unique opportunities here, so let's hear them. Send your written entries to John Curtis at the Curtis Catfinder address in the "Names And Numbers" box, or e-mail: jgcurtis@inreach.com

Please note that this is different from our usual contests, so please do NOT send your entries to me, Synergetics, or **Electronics Now Magazine**.

Some Tesla Books

As our resource sidebar for this month, I've gathered together a few of the more credible books that are by or about Nikola Tesla. Tesla's development of AC-power distribution, induction motors, and transformers was absolutely brilliant. His latter-day involvement with "free energy" and "earth resonant" sources clearly was not.

Tesla was quite strong in the lab but very weak in underlying theories. While he did experiment with radio and fluorescent lamps, so did many others. Sadly, a fundamentally wrong confusion between a resonant stored energy and actual sourced energy did seem to prevail in his later work.

Sorely misguided latter-day cultists have tried to deify Tesla, claiming lost secrets suppressed by the men in black, free-energy results, and even extra-terrestrial origins. Believable hard evidence for these outrageous claims has not been forthcoming.

Building one of those "lots of sparks" Tesla coils was once a rite of passage for techno-nerds who could not understand or afford girls. But these days, Tesla coils are just an illegal way of taking out a neighbor's TV set. Thousands of man hours of continuing research in EHV transmission and color TV and monitor

NAMES AND NUMBERS

Advance Transformer

10275 W Higgins Rd.
Rosemont, IL 60018
(708) 390-5000

Aremco

PO Box 429
Ossining, NY 10562
(914) 762-0685

Bell Jar

35 Windsor Dr.
Amherst, NH 03031
(603) 429-0948

Biomass & Bioenergy

PO Box 882
New York, NY 10159
(212) 633-3730

Curtis Catfinder

4345 Pacific Street
Rocklin, CA 95677
(800) 337-0901

Figaro

3703 W. Lake Ave., Ste. 203
Glenview, IL 60025
(847) 832-1701

Infotronix

PO Box 2045
Waterbury, CT 06722
(203) 756-6376

International Rectifier

233 Kansas St.
El Segundo, CA 90245
(310) 322-3331

Machine Design

1100 Superior Ave.
Cleveland, OH 44144
(216) 696-7000

Maxim

120 San Gabriel Dr.
Sunnyvale, CA 94086
(800) 998-8800

Microchip Technology

2355 W Chandler Blvd.
Chandler, AZ 85224
(602) 786-7200

Science/AAAS

1333 H St. NW
Washington, DC 20005
(202) 326-6400

Space-Time Productions

219 N Vale Ave.
Rockford, IL 61107

SPIE

PO Box 10
Bellingham, WA 98227
(206) 676-3290

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

Tektronix

PO Box 500
Beaverton, OR 97077
(800) 835-9433

Texas Instruments

PO Box 809066
Dallas, TX 75380
(800) 336-5236

Ultra Technology

2512 10th Street
Berkeley, CA 94710
(510) 838-2149

Vacuum Tube Valley

1095 E Duane Ave. Ste. 106
Sunnyvale, CA 94086
(408) 733-6146

Xilinx

2100 Logic Dr.
San Jose, CA 95124
(800) 244-7778

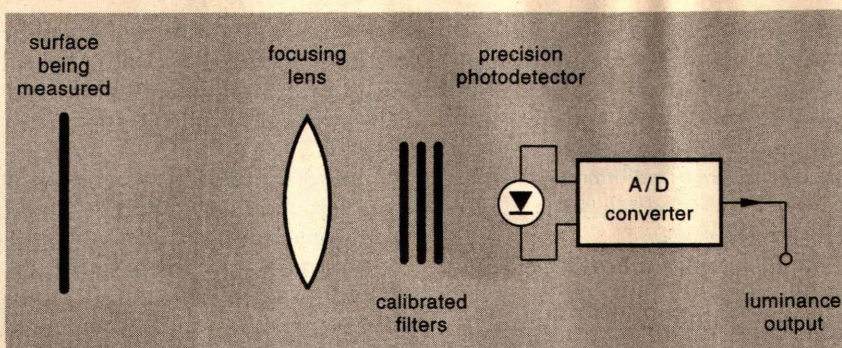


FIG. 2—LUMINOSITY IS MEASURED by imaging a surface, careful filtering, precision photodetection, and A/D conversion. The Tektronix J6523 is a typical instrument front end.

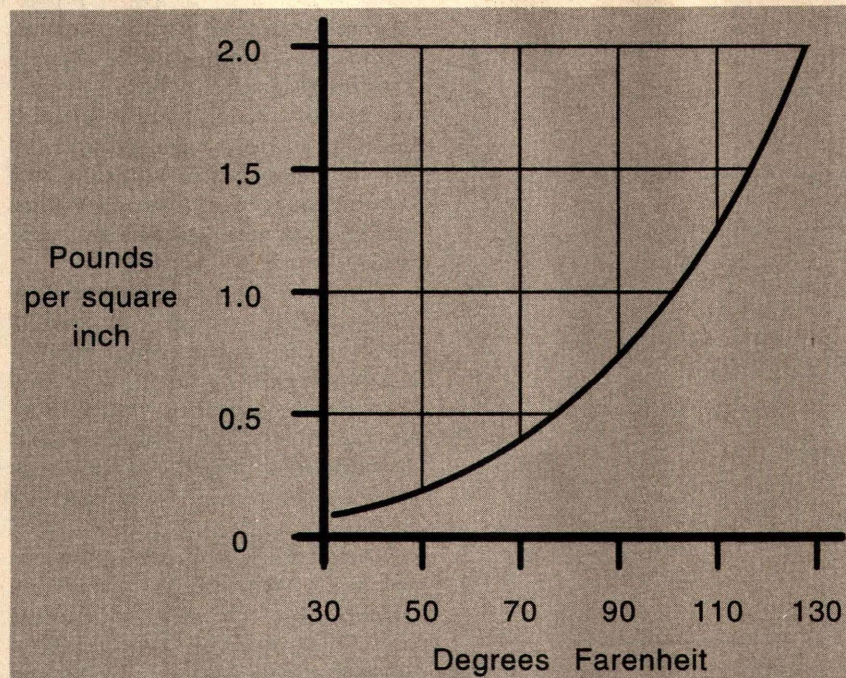


FIG. 3—HOW THE VAPOR PRESSURE OF WATER varies with temperature is shown here. When warm water remains present, only a weak vacuum can be created.

deflection leaves very little wiggle room for very much new or exciting. Other Tesla developments (such as bladeless turbines) largely remain inefficient lab curiosities.

Did Tesla get the credit he rightly and surely deserved? For openers, having a fundamental magnetic measurement unit named after you ain't half bad. Innovative originators rarely are recognized. For instance, powered human-attended heavier-than-air flight first originated in Australia. The most important thing the Wright brothers did was set back American aviation for decades through all their interminable patent battles on obsolete technology.

It seems that Edison had an aggressive propaganda mill that clearly forced Tesla out of the limelight. And for a crucial time, the US was at war with Tesla's native country.

Ongoing information on new titles can be located at www.tinaja.com/amlink01.html. Always start with the books by Tesla, rather than about him.

Log Graph Paper

A long-time Web site visitor asked me to repeat how to create your own log, semilog, or other graph paper by using PostScript. Some sample code is shown in Fig. 4. A more detailed example can be found in HACK59.PDF on my Web site.

What I really find amazing about a PostScript plot or graph is that it can easily do the underlying math. For instance, the Web version of Fig. 1 actually calculates out the luminosity curve, giving good color matches. Decibel conversions, of course, end up trivial. Most of the fancy plots you see in these columns are in fact calculated directly from theory. This can be done once under PostScript-as-lan-

BOOKS ON OR ABOUT NIKOLA TESLA

- My Inventions (Nikola Tesla)
- Advances in Tesla Technology (Nick Begich)
- Fantastic Inventions of Nikola Tesla (David Hatcher)
- In Search of Nikola Tesla (David Peat)
- Nikola Tesla: A Spark of Genius (Carol Donnermuth-Costa)
- Nikola Tesla's Earthquake Machine (Dale Pond)
- Nikola Tesla Returns (Robert Reichman)
- Streams of Lenard and Roentgen (Nikola Tesla)
- TCBA Guide to the Colorado Springs Notes (Richard Hull)
- Tesla: Man Out of Time (Margaret Cheney)
- Wizard: The Life and Times of Nikola Tesla (Marc Seifer)

guage and then is shoved into Distiller to make a fast (and calculation free) final image.

I've shown the code here in "raw" PostScript. My own PostScript "gonzo" utilities would normally be used to add power and convenience.

PostScript can be a superb general-purpose computer language that is easy to use and scads of fun to play with, especially for graphics, video, and robotics. Additional details are found at www.tinaja.com/post01.html and www.tinaja.com/acrob01.html

New Tech Lit

From Texas Instruments, there's the new Convert Analog data CD. And from Microchip Technology, comes a new update of their Technical Library CD.

I just got wind of a new scheme that lets you design your own custom microprocessors, microcontrollers, or DSPs—ones that do your things your way. The trick is to start with a large and cheap programmable gate array, such as the XC4005L from Xilinx or others. It turns out there is an outfit called Space-Time Productions who provide evaluation and configuration cards, along with lots of free support software in the form of a Forth-based scripting language. More DYOP details can be found at www.tefbbs.com/spacetime/index.html. One DYOP distributor is Ultra Technology, whose Web site is found at www.dnai.com/~jfox/store.htm. I'll try to do a lot more on this one after I find time for a closer look.

Some interesting castable ceramic products and materials are provided by Aremco, while a wide range of gas sen-

sors is offered by Figaro.

SPIE is a little-known and low-profile outfit that puts on conferences and resells great heaping bunches of first-rate optical and sensing technical papers and tutorials.

Low Cost Electronics Projects is a new Fred Blechman book. Details at www.tinaja.com/amlink01.html

Information on tiny gas turbines

small enough to easily and efficiently replace a size D flashlight cell appeared on page 8 in the October, 8, 1998 issue of *Machine Design*. A typical premium flashlight cell offers 50-watt-hours of energy per liter; gasoline can offer 9600.

A new electrical safety site is up at www.safetylink.com

Fluorescent lamp dimmers with a full

dimming range are newly offered by Advance. A MAX1005 sampler IC for digital radio downconversion has been announced by Maxim. Lots of possibilities here.

Biomass & Bioenergy is a scholarly journal from Elsevier. *Vacuum Tube Valley* has an interesting and useful mix of historic and modern vacuum tube stuff in it. One useful source for antique amateur and amateur radio manuals is Infotronix. More details on finding tech manuals in general are at www.tinaja.com/resbn01.html

Free samples of FETKY miniature powerMOS transistors can be obtained from International Rectifier.

For the insider secrets of easily designing your own op-amp filters, read my *Active Filter Cookbook*, either by itself or as a portion of my Lancaster Classics Library. Find more details per my nearby Synergetics ad.

Latest Web-site additions include Webmastering secrets, new "virtual ways" Hexapod robotic links, 24/7 publishing, a brand new user forum, and much more on military surplus electronics. You'll find all of these at www.tinaja.com/whtnu01.html More on instant technical solutions at www.tinaja.com/info01.html

I've got some great new bargains on my surplus Web page. Everything from Tektronix plug-ins to new AC motors to classic Apple collectibles to load banks for windmill testing. You can pick up your free catalog at www.tinaja.com/bargte01.html

As usual, most of the mentioned items should appear in our Names and Numbers and Books On or About Nikola Tesla sidebars. Be sure to check here before calling our US technical helpline. **EN**

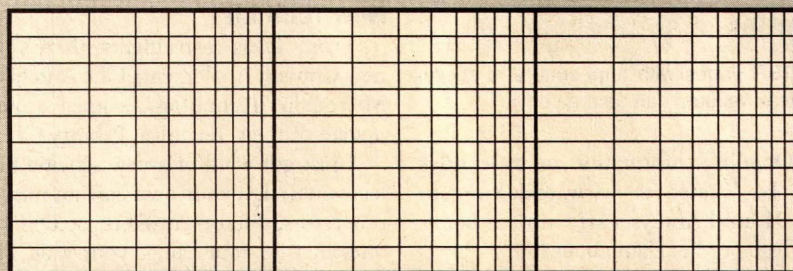
Let's hear from you.



```
gsave 100 100 translate 10 dup scale    % position and scale
72 600 div setlinewidth                  % draw log lines
1 1 10 {log 10 mul 0 moveto 0 10 rlineto stroke} for
10 10 100 {log 10 mul 0 moveto 0 10 rlineto stroke} for
100 100 1000 {log 10 mul 0 moveto 0 10 rlineto stroke} for
1 1 10 {log 10 mul 0 exch moveto 30 0 rlineto stroke} for

72 300 div setlinewidth                  % emphasize decades
10 0 moveto 0 10 rlineto stroke
20 0 moveto 0 10 rlineto stroke

72 150 div setlinewidth                  % emphasize outlines
0 0 moveto 0 10 rlineto 30 0 rlineto 0 -10 rlineto closepath stroke
grestore
showpage
```



```
gsave 100 100 translate 10 dup scale    % position and scale
72 600 div setlinewidth                  % draw log lines
1 1 10 {log 10 mul 0 moveto 0 10 rlineto stroke} for
10 10 100 {log 10 mul 0 moveto 0 10 rlineto stroke} for
100 100 1000 {log 10 mul 0 moveto 0 10 rlineto stroke} for
1 1 10 {exch moveto 30 0 rlineto stroke} for

72 300 div setlinewidth                  % emphasize decades
10 0 moveto 0 10 rlineto stroke
20 0 moveto 0 10 rlineto stroke

72 150 div setlinewidth                  % emphasize outlines
0 0 moveto 0 10 rlineto 30 0 rlineto 0 -10 rlineto closepath stroke
grestore
showpage
```

FIG. 4—HERE'S THE POSTSCRIPT CODE you can use to make log and semilog graph paper.

ELECTRONIC GAMES

BP69—A number of interesting electronic game projects using IC's are presented. Includes 19 different projects ranging from a simple coin flipper, to a competitive reaction game, to electronic roulette, a combination lock game, a game timer and more. To order BP69 send **\$4.99 clearance (includes s&h)** in the US and Canada to **Electronic Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240**. US funds only. Use US bank check or International Money Order. Allow 6-8 weeks for delivery. **MA07**



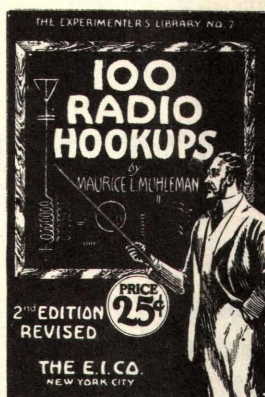
Electronic SHOPPER[®]

Paperback Books

GREAT BOOKS AT BUDGET PRICES

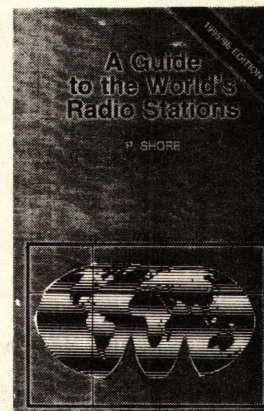
☐ **100 RADIO HOOKUPS**
—#7—\$3.00

First published in May, 1923 this popular booklet went into reprint editions nine times. It is packed with circuits, theory, antenna installation and tips on consumer radio receivers that were popular in the early 1920's. Antique radio buffs and those inquisitive about the early days of radio will find this booklet an exciting, invaluable and excellent reference into the minds of early-day radio listeners. Sorry, we cannot honor the original 25-cent cover price.



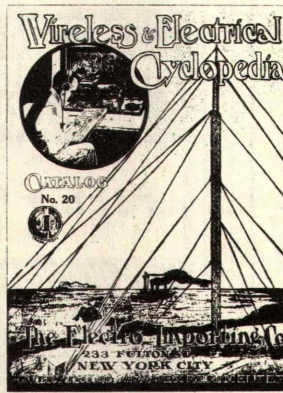
☐ **GUIDE TO THE WORLD'S RADIO STATIONS**
—BP355—\$10.99

An easy-to-read guide for the casual listener and top notch QSL getter! The Guide is an essential reference work designed to steer the listener around the ever more complex radio bands. Listings cover world-wide shortwave stations with a special emphasis on international broadcasts in English. Medium and long-wave listings are also included for the US, Canada, European, Middle and Near East, and North Africa regions.



☐ **THE INTERNET AND WORLD WIDE WEB EXPLAINED** —BP403—
\$10.99

Strip away the hype and mystery of the WWW and you'll be cruising on the information Superhighway! Understand the jargon used: ftp, protocols, TCP, hypertext, http, URL, home pages, threads, HTML, domains, FAQs, etc. Discover that e-mail is easy, fast and free! Learn how to guard against hackers and viruses. Develop friendships and "buddies" in Singapore, India, Cape Town, Peru—just about anywhere!



☐ **WIRELESS & ELECTRICAL CYCLOPEDIA**
—ETT1—\$5.75

A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the radio parts and receivers shown, it's very unlikely that it will be available.

ELECTRONIC TECHNOLOGY TODAY INC.
P.O. BOX 240, Massapequa, NY 11762-0240

Name _____
Address _____
City _____ State _____ Zip _____

SHIPPING CHARGES IN USA AND CANADA	
\$0.01 to \$5.00	\$2.00
\$5.01 to \$10.00	\$3.00
\$10.01 to 20.00	\$4.00
\$20.01 to 30.00	\$5.00
\$30.01 to 40.00	\$6.00
\$40.01 to 50.00	\$7.00
\$50.01 and above	\$8.50

SORRY No orders accepted
outside of USA & Canada

Total price of merchandise	\$ _____
Shipping (see chart)	\$ _____
Subtotal	\$ _____
Sales Tax (NYS only)	\$ _____
Total Enclosed	\$ _____

All payments must be in U.S. funds!

ET01

INTERNET SECURITY

The latest tricks and methods being used on the Net by software pirates (warez) and their newest hacking websites. How they do it, countermeasures, password defeats, UNIX, Sprintnet, brute force techs, lots of tips. **More!** \$29. EWC=29.4K

INTERNET TRACKING & TRACING: Scammers, spammers, stalkers, infectors, and others hide behind the Internet's anonymity to commit serious offenses. Learn from master hackers best methods to track, trace IDs and origins, and to protect your own privacy. **More!** \$29. EWC=17.0K

INTERNET FRAUDS DATABASE: Internet cons, scams and related frauds now rake in \$2+ billion annually! Most are done anonymously with impunity. Details how they're done, how to ID them, how to protect yourself. **More!** \$25. EWC=18.9K

THE COOKIE TERMINATOR: Many websites track your every move! Browser cookie, history and cache files contain personal data readily accessible to Internet predators, scammers, spammers and snoops. Your financial, medical, political, habits, lifestyle, future plans data is exposed to the world! Step-by-step how to remove and stop cookies from destroying your privacy. \$25. EWC=8.4K
Any 2 for \$49, 3 for \$64, all 4 for \$79!

PBX SECURITY: PBXs hacking losses of \$5-\$10 Billion/yr! Detailed vulnerabilities, countermeasures. Author interview in Forbes! \$24. EWC=17.4K

TOP SECRET

CELLPHONE/CORDLESS GUIDE

How cellphones operate; mods. Vulnerabilities to hack attack; countermeasures. Cloning details for NAMS, ESNs, etc, control data formats, computing encoded MINs, ESNs, SIDHs, Op Sys, PROMs, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, step-by-step to keypad-reprogram 100+ popular cellphones. One FREE database search. Plus much on Cordless phones. **More!** \$49. EWC=80.2K

PAGER (BEEPER) MANUAL: How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How phreaks hack Pagers; countermeasures. And plans for a Personal Pocket Paging System (xmitter and receiver). **More!** \$29. EWC=11.4K

Both for only \$69!

CALLER ID & ANI SECURITY: How they work and the many vulnerabilities of Caller ID, ANI, *69, *57, Call Blocking, *67, et al. Describes ESS, S57, CNA, CAMA, DNR, Diverters, Centrex! \$25. EWC=15.2K

FAX MACHINE SECURITY: All known methods used to hack Faxes and countermeasures. Includes computer fax modems, crimes, interceptions, fax servers, fax-on-demand, protocols, parameters, compression, encryption, and fax surveillance-type mods. **More!** \$29. EWC=28.7K

VOICE MAIL SECURITY: VMS are hacked to penetrate PBXs to make outgoing calls, get free VMB usage, secretly read/change/delete messages, or damage the VMS (or its PBX) itself. Details how hackers do it, countermeasures. \$29. EWC=14.2K

CONSUMERTRONICS

2430 Juan Tabo, NE, #259, ABQ, NM 87112
P.O. Box 23097 ABQ, NM 87192
Fax: 505-292-4078 (all hours, orders only) Voice: 505-237-2073 (9-5 M-S)

Full Catalog: www.tsc-global.com Special Projects: www.spaf-spp.html

Established in 1971. Featured on CBS "60 Minutes", Forbes, New York Times. Add \$5 total S/H (US, Canada). Postal MO is fastest! VISA, MC OK. No CODs. 10% OFF all Orders over \$100; \$2.00 OFF all New Orders over \$20 placed by Mail or Fax. Catalog \$1 w/order, \$3 w/o. EWC=Estimated Word Count

Sold for legal educational purposes only to protect you from hi-tech crimes and abuses! See Catalog for LIMITED WARRANTY, SPECIAL PROJECTS and all other applicable policies!

SPM - THE MANUAL

As reported on "60 MINUTES"! 6th Edition! Details devices that can slow down (even stop) power meters while loads draw full power - great science projects! Devices plug into one outlet and normal loads into other outlets. Describes meter creep, overload droop, pole meters, etc. \$29. EWC=10.4K

SPM THE VIDEO: Now its easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM-related manuals! \$29. (20 min)

THE I.G. MANUAL: Details external magnetic ways (applied to meters) hackers use to slow down and stop power meters while drawing full loads. \$25. EWC=4.9K

KW-HR METERS: How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. \$25. EWC=24.2K

Any 2 for \$49, 3 for \$64, all 4 for \$79!

COMPUTER SECURITY

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk! \$39. EWC=54.7K

THE HACKER FILES: Expose 3 HD PC disks filled with choice raw, colorful, highly informative hacker, phreaker text files covering many topics! \$39. Both for only \$69!

BEYOND VAN ECK TEMPEST

Plans for remote eavesdropping of TV video signals. Range up to 1 KM. Describes how van Eck systems work, and are also used in surveillance of computer systems. \$29. EWC=10.6K. Van Eck Demo Tape is \$29. (15 min). Both for only \$49!

MANY MORE TITLES!

(See Catalog for prices & descriptions)
BEYOND PHONE COLOR BOXES
ANSWER, MACHINE SECURITY
CASINO SECRETS
ATM SECURITY
CHECK & M.O. SECURITY
CREDIT CARD SECURITY
CONS & SCAMS DATABOOK
SOCIAL ENGINEERING
POLYGRAPH SECRETS
BY AN ORDER OF THE MAGNITUDE
ULTIMATE SUCCESS MANUAL
STEALTH TECHNOLOGY
SIMPLE/CHEAP SECURITY ELEC.
SECRET & SURVIVAL RADIO
HIGH VOLTAGE DEVICES
MIND CONTROL
UNDER ATTACK!
RADIONICS MANUAL
HEAL THYSELF!
SECRETS OF SOLDERLESS BBS
SECRET & ALTERNATE IDS
CRYPTANALYSIS TECHNIQUES
GOVERNMENT LAND GRAB
ROCKET'S RED GLARE
SURVIVAL GUNS & AMMO
THE ULTIMATE DRIVER

THE DIRTY-2 DOZEN!

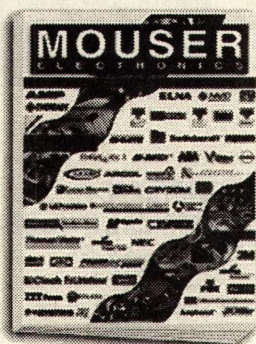
24+ Hot Hack/Phreak Expose Disks!

See CATALOG!

SPECIAL PROJECTS

We will design & build just about anything electronic! Hardware done as SPECIAL PROJECTS only. See Catalog for details and SP Application Form, else: www.tsc-global.com/spaf-spp.html

ELECTRONIC COMPONENTS



Visit our web site!
www.mouser.com

Subscribe, download, or view catalog online!

- Over 78,000 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

800-992-9943

817-483-6828 Fax: 817-483-6899
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

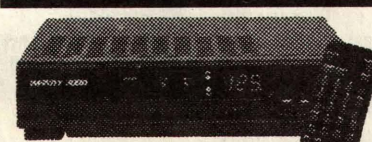
Call Today And **SAVE!** **Unbeatable PRICES!**

CABLE TV

DESCRAMBLERS
CONVERTERS • FILTERS
VIDEO STABILIZERS

FREE ➤ 30 Day Trial
FREE ➤ Product Catalog
FREE ➤ 1 Year Warranty

100% MONEY BACK GUARANTEE



Let us point you in the right direction ...

Arrow Technologies
Omaha, Nebraska

TOLL FREE
888-554-ARROW
888-554-2776

FCC License Preparation

Electronics Tech., Avionics, Marine & Radar
HOMESTUDY—Fast, Easy & Inexpensive
Manuals, Audio, Video, PC disks, latest Q&As
Free 1-800-800-7555 "Guaranteed Pass"
See at <http://www.worldaccessnet.com>
BusinessShowcase/wpt. 4701 NE 47th St.
Vancouver, WA 98661 - WPT Publications

Quality Microwave TV Systems

WIRELESS CABLE - IFTS - MMDS
ATV - INTERNATIONAL - DIGITAL
Amplifiers • Antennas • Books • Components
• RF Frequency 2100-2700 MHz
• SASE For "FREE" Catalog or Send \$1

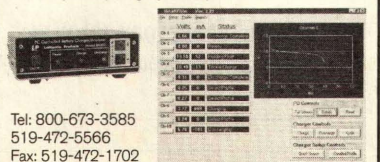
PHILLIPS-TECH ELECTRONICS
P.O. Box 13074 • Scottsdale, AZ 85267-3074
CATALOG/INFO: 602-947-7700
ORDER LINE: 800-880-MMDS
FAX LINE: 602-947-7799
WEBSITE: www.phillips-tech.com
E-MAIL: product@phillips-tech.com
Visa • M/G • AmEx • Discover • COD's • Quantity Pricing

CHALLENGER SYSTEM
31 Channel Complete \$240
5 Year Warranty
FREE SHIPPING

Battery Analyzer

— — — — — +

PC-Controlled Battery Analyzer
Cycle, Charge & Test with your PC
Print reports, plot graphs, expandable **\$398**



Tel: 800-673-3585
519-472-5566
Fax: 519-472-1702

Download Demo: **LaMantia Products Ltd.**
<http://home.rogerswv.ca/lamantia>
lamantia@compuserve.com

BREAK-THROUGH IN SURFACE MOUNT REWORK

We have put together a very inexpensive package for reworking fine pitch surface mount components with a minimum amount of expertise and technical ability. If you can use a soldering iron effectively, then you can remove and replace most surface mount components fast, effectively and at a very low temperature. You will soon make them look like they have never been replaced. Read on to find out more about this exciting new product.

With the EDSYN soldering iron pictured, or any EDSYN Soldering Iron, and a special EDSYN soldering tip called the Mini-Wave Soldasip®, and the patented SMD-1 rework kit from CHIP QUIK®, most SMD's can be replaced very effectively and inexpensively. CHIP QUIK® alloy (which melts at 136° F), is applied to the solder points of the device. The 136° melting point of the low temperature alloy is mixed with the solder on the chip, to bring the melting point of the mixture much lower than normal, allowing the SMD to be removed with a set of tweezers. Clean-up is then accomplished with the accessories in the kit. After clean-up the IC is aligned and tacked down with regular solder on opposing corners.

EDSYN
951SX



The new Mini-Wave Soldasip® tip from EDSYN is a cylindrical tip cut at a 45° angle on the end. The tip end is cupped, or concave, so it will hold solder in the cup. Flux is then applied to the leads of the IC and regular wire solder applied to the cup of the mini-wave tip. Holding the iron at a 45° angle, drag the solder tip parallel to the body of the IC or perpendicular to the leads. The solder in the cup of the tip is then applied to leads of the IC making a permanent bond between the leads and the pads of the PC Board. If bridging occurs, it is usually because of too much solder in the cup. Clean the tip with the sponge and wipe the bridge away from the IC with the tip. If the bridge does not clear, simply apply more flux and repeat the wipe and it will clear.

In my years of experience, I have never seen a more effective way of replacing a surface mount. It also happens to be the most inexpensive. Check out our package price and you will see why I am so excited about this. For more information on this package go to <http://www.heinc.com/951sxt.html>.

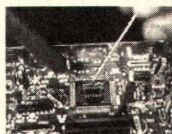


Five Easy Steps

Apply Flux



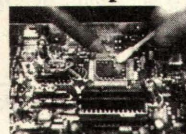
Apply Alloy



Remove IC



Clean up Area



Replace IC



- 1 - EDSYN 951SX Temperature Controlled Solder Station
- 1 - Mini-Wave Soldasip® Tip
- 1 - SMD-1 Chip Quik® Removal Kit

\$135.00
Order Now

For more info on Soldering & Desoldering go to <http://www.heinc.com>

For more information on this package please go to <http://www.heinc.com/951sxt.html>

Visa - M/C - Discover - American Express - Terms to Qualifying Companys
30 Day Money Back Total Satisfaction Guarantee - 18 Month Parts and Labor Warranty

Howard Electronic Instruments, Inc. 6222 N. Oliver Kechi, KS 67067

HOWARD
HEI ELECTRONIC
INSTRUMENTS
Your Desoldering Specialists **INC**

Toll Free U.S. and Canada

1-800-394-1984

Web Site www.heinc.com
E-Mail sales@heinc.com
International (316) 744-1993
or Fax (316) 744-1994

CIRCLE 331 ON FREE INFORMATION CARD

2539 W. 237th Street, Bldg. F, Torrance, CA 90505
 Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
 L.A. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
 OEM INQUIRIES WELCOME

TIMELINE INC.

Over 13 years and 31,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.

AND 4021ST-EO. Unit is EL backlit. \$59.00 or 2 for \$109.00 or OPTREX DMF5005 (non backlit) \$49.00 or 2 for \$89.00

20 character x 8 line 7/16" x 2 1/8" The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1.....\$7.00	20x2.....\$10.00	32x2.....\$8.00
16x1 (lg. char.).....\$10.00	20x4.....\$15.00	40x1.....\$8.00
16x2.....\$7.00	20x4 (lg. char.).....\$10.00	40x2.....2 for \$20.00
16x2 (lg. char.).....\$10.00	24x2.....\$10.00	40x4.....\$20.00
16x4.....\$15.00	32x4.....\$10.00	4x2.....\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$10.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25.00

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz. • Ability to do 40 and 80 column.
 5 inch Amber \$25.00 • 7 inch Amber \$25.00
 9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.00

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69.00

9" COLOR SVGA MONITOR \$179.00 Fully Enclosed - Tilt and swivel type.

POS & BAR CODE

MAGNETIC CARD READER \$25.00

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300) \$19.00

HACKER CORNER

EMBEDDED 486 COMPUTER \$99.00

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8" x 6-5/8" x 3-1/8") case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BKB) \$29.00

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$49.00 2 for \$89.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Encased Spread Spectrum RF Modem \$99.00

The ProxLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProxLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MZ spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProxLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub - D) interface, and small (~4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

COLOR CCD CAMERA \$89.00

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

CIRCLE 275 ON FREE INFORMATION CARD

ELECTRONIX EXPRESS

WELLER SOLDERING STATION - MODEL WLC 100

- Variable power control (5 to 40 watts)
- Replaceable heating element
- Quality light-weight pencil iron

\$36.95



DUAL-TRACE OSCILLOSCOPE

W/HIGH RESOLUTION, BLUE CRT
 INCLUDES PROBES, POWER CORD
 2 YEAR WARRANTY
 Goldstar 5020
 20MHZ \$349.00



SCOPE PROBE 60 MHZ \$12.95

SWITCHABLE X1, X10

DIGITAL MULTIMETER

WITH CAP/FREQUENCY/
 TRANSISTOR TESTER
 Model DM645 \$34.95



PAD-234

DIGITAL/ANALOG TRAINER

Complete portable workstation. Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.

Assembled \$150.00 Kit \$110.00



INSTEK® FUNCTION GEN.

WITH INT/EXT
 FREQ. COUNTER
 MODEL 8016 \$215.00



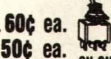
ALLIGATOR LEADS

SET OF 10 \$2.10



SWITCHES

8 POS DIP 60¢ ea.
 Mini Toggle SPDT 50¢ ea.



HIGH QUALITY TOOLS

With Cushion Grips and Return Spring

Needle Nose Pliers \$2.95
 Wire Stripper \$1.50
 Diagonal Cutter \$2.95

POWER SUPPLIES
 0-30 VDC, 0-3 Amp. Built-in current limiting, overload protected, constant voltage and current operation.

01PSGP4303A Analog Display \$165.00
 01PSGP4303D Digital Display 189.00



SOLDERLESS BREADBOARD

830 tie points. MB102PLT model features 3 binding posts and aluminum backplate.

Part No.	1-9	10+
MB102	5.95	5.00
MB102PLT	8.95	8.00



HELPING HAND \$3.50

1/4W 5% film. 5 pieces each of 73 values. 365 pieces total.

MOTION DETECTOR \$2 ea. - 10 For \$15

LM555 10 Min. 22¢ ea.
 LM741 10 Min. 27¢ ea.
 74LS00 10 Min. 18¢ ea.
 7805 Regulator 10 Min. 30¢ ea.
 2N3904 10 Min. 6¢ ea.
 PN2222 10 Min. 6¢ ea.
 Red LED T 1 1/4 10 Min. 6¢ ea.
 Green LED T 1 1/4 10 Min. 7¢ ea.
 Yellow LED T 1 1/4 10 Min. 8¢ ea.
 Photo Cell 10 Min. 65¢ ea.
 100K Pot., 1" Shaft PC Mt. 10 Min. 15¢ ea.

RESISTOR KIT \$3.95

#060836

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

SOLDERING IRON 3-WIRE

HIGH PERFORMANCE \$5.25

#060501

SOLDERING IRON STAND

W/SPONGE \$3.50

#060842

1 LB. 60/40 Solder Roll .031" \$5.95

DESOLDER PUMP \$3.50

W/TIP #060820

15 TURN POT 7 SEG. DISPLAY

69¢ ea. 60¢ ea.

Bourns 3006P series. All standard values available.

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

MAN72 C.A Red 0.3" MAN74 C.C Red 0.3"

In NJ: 732-381-8020
 FAX: 732-381-1572

365 Blair Road • Avenel, NJ 07001-2293

800-972-2225

http://www.elexp.com
 email: electron@elexp.com

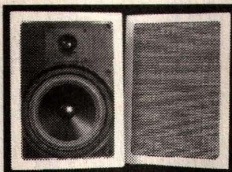
CIRCLE 323 ON FREE INFORMATION CARD

PARTS EXPRESS

ELECTRONICS & MORE

6-1/2" Two Way System

This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theatre sound and still fit everyone's budget. Put a pair in every room of your house.



Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theatre in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap.

Specifications: ◆6-1/2" polypropylene cone woofer with poly foam surround ◆1" textile dome tweeter/midrange ◆8 ohm impedance ◆3 component L/C crossover network ◆Frequency response: 50-20,000 Hz ◆Power handling capability: 60 watts RMS/85 watts max ◆Sensitivity: 89 dB 1W/1m ◆Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D ◆Hole size: 7-1/4" x 10-3/4" ◆Fits into standard 2" x 4" wall ◆Net weight: 12 lbs. per pair.

#300-036 \$89.90 (1-3 PRS) \$79.50 (4 PRS-UP)

Satellite Speaker Stands

These quality speaker stands are perfect for mini or rear surround speakers. The heavy die cast base provides stability. Textured black satin finish blends in well with any decor. The height is adjustable from 26-1/2" to 47-1/2" and the speaker wire can be run inside the pole for a better appearance. The top base is adjustable from 4-1/8" to 7-1/2" to accommodate most mini speakers. Includes foam pads to prevent marring of speaker cabinet. Sold in pairs. Net weight: 12 lbs.



#240-762 \$39.80 (1-3 PRS) \$35.50 (4 PRS-UP)

5 Function Remote

◆Operates five devices (TV, VCR, Cable, Satellite, A/V Receiver)
◆Lighted component keys which indicate what device is currently being used ◆Preprogrammed, 621 codes that work over 6,400 models ◆New ergonomic design features a contoured case, index finger grooves, and keys grouped in clusters for easy operation ◆Satellite cursor control is tailored for use with a Home Theatre system, keypad design allows movement through menus with ease ◆Retains codes when replacing batteries ◆New flat back design for easy operation ◆Money back guarantee ensures customer satisfaction ◆Toll free customer service number provides the customer with friendly, knowledgeable assistance ◆Requires 2 AAA batteries (140-150 not included)



#180-806 \$29.95 (1-3) \$26.95 (4-UP)

3M 3/4" Temflex™ 1700 Vinyl Electrical Tape

General purpose 7 mil electrical tape. UL listed and CSA approved. 3/4" x 60' rolls.



#350-052 75¢ (1-9) 59¢ (10-UP)

Gold Plated A/V Cables

A super quality, "siamesed" type cable. Two RCA cables for stereo (audio) signal from VCR to receiver/stereo TV and one low noise coaxial type cable for video.



Part #	Length	Price (1-9)	Price (10-UP)
180-120	3 ft.	\$4.25	\$3.95
180-118	6 ft.	4.90	4.50
180-121	12 ft.	8.95	7.95
180-124	20 ft.	12.75	11.50

If you haven't received a copy of our current 260 page catalog ... have one added to your order or give us a call and we will send one out to you immediately.



6-1/2" Round Coaxial System

Dayton Loudspeaker Co.

Designed for the home and office, these 6-1/2" round in-walls are ideal for ceiling installations, or for use as rear channel surround speakers. Adding music to the kitchen, den, bath, or patio has never been easier! System features a weather resistant 6-1/2" treated paper cone with poly foam surround, coaxially mounted 1/2" polymer dome tweeter, and built-in crossover with a mylar capacitor in the tweeter feed. Retrofit design allows installation in both new and existing construction in just minutes. System includes removable steel mesh grills, built-in mounting bracket, hardware, and installation instructions.

Specifications: ◆Impedance: 8 ohms ◆Frequency response: 60-20,000 Hz ◆Power handling capability: 30 watts RMS/45 watts max ◆Sensitivity: 89 dB 1W/1m ◆Dimensions: 9" round x 2-7/8" deep ◆Net weight: 5 lbs. per pair.



#300-408 \$69.95 (1-3 PRS) \$62.75 (4 PRS-UP)

3 Amp Power Supply

ZURICH

This fully regulated power supply is perfect for powering CBs, car radios, and other 12 VDC devices that draw up to 3 amps. Heavy duty steel housing with front mounted switch and binding posts. Short circuit and overload protection!



Specifications: ◆Output Voltage: 13.8 VDC (fixed) ◆Output Current: 3A (cont), 5 amps (surge) ◆Ripple Voltage: Less than 3mV at rated output ◆Input Voltage: 120 VAC, 60Hz ◆Dimensions: 5-1/2" x 3-1/2" x 6-1/2" ◆Weight: 5 lbs.

#120-530 \$19.95 (1-3) \$18.50 (4-UP)

DMM and LCR Meter

In addition to functions found in regular DMM's, this meter can also measure inductance in 5 ranges (4mH, 40mH, 400mH, 4H, 40H), capacitance in 5 ranges (4nF, 40nF, 400nF, 4uF, 400uF), frequency in 4 ranges (4KHz, 40KHz, 400KHz, 4MHz), TTL logic test, diode test and transistor hFE test. 5 AC/DC ranges up to 1000V (AC750V), 3 AC/DC current ranges up to 20A and 7 resistance ranges up to 4000 M ohms. Includes test leads, battery, spare fuse, and manual. Net weight: 1 lb.



#390-513 \$85.90 EACH

2.5W Mini Audio Amplifier

This amp contains both pre-amplifier and power amplifier on a super small board measuring only 1-5/8"x1-1/4". Maximum output power is 2.5W into 4 ohms with 12VDC input power. No adjustments required. Short circuit protected.



#320-215 \$9.95 EACH

Weller WLC100 Soldering Station

The Weller WLC100 solder station is ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost of an industrial unit. Power is adjustable from 5 to 40 watts. Includes 40 watt pencil iron. UL approved. Net weight: 1-3/4 lbs. Replacement sponge #372-119.



#372-120 \$39.95 EACH

"44" Solder

Kester "44" rosin core solder is designed for electronic and electrical work. It uses a fast acting, instant wetting, non-corrosive, and non-conductive flux for faster soldering and a strong, long lasting bond.



Part #	Alloy Lead/Tin	Spool	Dia.	Price (1-3)	Price (4-UP)
370-080	60/40	1 lb.	.031"	\$8.50	\$7.95
370-090	60/40	1 lb.	.050"	8.50	7.95
370-098	60/40	4 lb.	.031"	33.90	31.80
370-088	60/40	1/2 lb.	.020"	6.95	5.75
370-072	63/37	1 lb.	.020"	14.90	13.50
370-086	63/37	1/2 lb.	.031"	9.95	8.50
370-074	63/37	1 lb.	.031"	12.50	11.50
370-087	36/37	1/2 lb.	.031"	7.95	6.75

Pro Wick

Pro Wick's advanced fine braid design provides wicking action that is second to none.



Part #	TS #	Size	Length	Price (1-9)	Price (10-UP)
341-415	1802-5	.06"	5'	\$1.40	\$1.25
341-416	1803-5	.08"	5'	1.45	1.30
341-417	1804-5	.10"	5'	1.60	1.45
341-424	1802-10	.06"	10'	2.75	2.50
341-425	1803-10	.08"	10'	2.80	2.55
341-426	1804-10	.10"	10'	2.95	2.70
341-440	1802-25F	.06"	25'	6.80	6.30
341-441	1803-25F	.08"	25'	6.85	6.35
341-442	1804-25F	.10"	25'	7.60	7.00
341-418	1802-100	.06"	100'	21.90	20.50
341-419	1803-100	.08"	100'	21.90	20.50
341-423	1804-100	.10"	100'	23.90	22.50

725 Pleasant Valley Dr., Springboro, OH 45066-1158
Phone: 513-743-3000 ◆ Fax: 513-743-1677
E-mail: sales@parts-express.com

KEY CODE: ENMI

LARGEST SELECTION OF SPEAKER DRIVERS IN THE COUNTRY!

VISIT OUR WEB SITE AT
www.parts-express.com
OR CALL TOLL FREE
1-800-338-0531



Ask for a free
copy of the
1998/99
Newnes catalog,
item #645.

Newnes

Publishers for the Electronics Industry

For more
information on
these books, visit
our web site:
www.bh.com

Newnes Circuit Series by Rudolf F. Graf



0-7506-9877-2
Paperback
208pp
\$24.95



0-7506-9878-0
Paperback
192pp
\$24.95



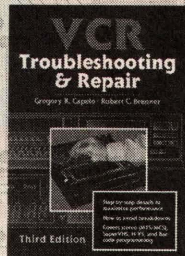
0-7506-9879-9
Paperback
224pp
\$24.95



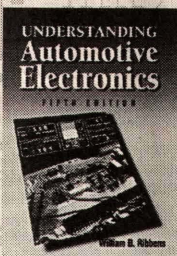
0-7506-9882-9
Paperback
240pp
\$24.95



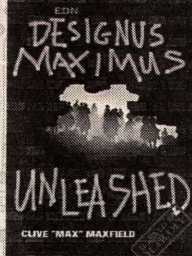
0-7506-9883-7
Paperback
192pp
\$24.95



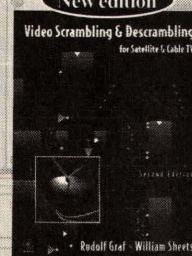
0-7506-9940-X
Paperback
356pp • \$27.95



0-7506-7008-8
Paperback
392pp • \$29.95



0-7506-9089-5
Paperback w/CD
448pp • \$39.95



0-7506-9997-3
Paperback
292pp • \$29.95



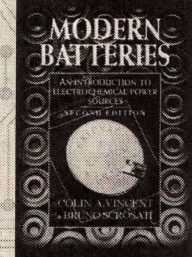
0-240-80296-9
Paperback
457pp • \$39.95



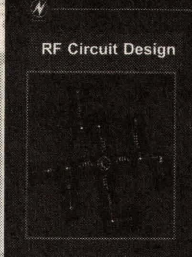
0-7506-9944-2
Paperback
367pp • \$24.95



0-7506-9891-8
Paperback
208pp • \$34.95



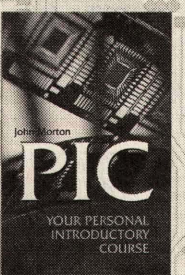
0-7506-7092-4
Paperback
352pp • \$49.95



0-7506-9946-9
Paperback
176pp • \$24.95



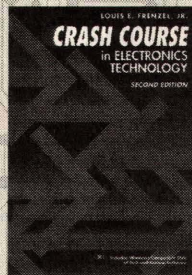
0-7506-7062-2
Paperback
416pp • \$29.95



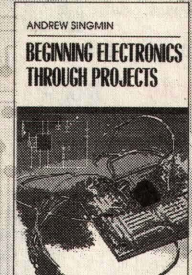
0-7506-3932-6
Paperback
160pp • \$24.95



0-7506-9709-1
Paperback w/disk
\$36.95



0-7506-9710-5
Paperback w/disk
392pp • \$39.95



0-7506-9898-5
Paperback
120pp • \$19.95



0-7506-2337-3
Paperback
272pp • \$44.95

Please send me the book(s) listed below.

Write book number(s) here:

Mail your order to: Butterworth-Heinemann, Fulfillment Center, 225 Wildwood Ave., Woburn, MA 01801 USA

Name

Address

City State Zip

Phone Fax

E-mail

Visit our web site: <http://www.bh.com>

Phone: 1-800-366-BOOK Fax: 1-800-446-6520

E-mail your order to orders@bhusa.com

☐ I have enclosed a check for \$

☐ Please charge my:

☐ Visa ☐ MasterCard ☐ American Express

Card no. Exp. date

Signature

U.S. Customers: Please add \$4.00 handling fee for the first item ordered, \$1.50 for each additional item, to all check and credit card orders. Billed orders will be charged additional shipping based on weight and destination. All U.S. orders must include your state sales tax. Prepayment or company purchase order is required for all orders. Prices subject to change without notice.

Canadian Customers: Please pay by credit card or in U.S. funds and include 7% GST on books and handling.

European Customers: Add £2.00 UK and surface postage. ☐ Check for Air Mail; extra cost will be charged.

An imprint of Butterworth-Heinemann

TS250

MCM ELECTRONICS®

The Source For All Of Your Electronics Needs

When ordering, please provide this code: **SOURCE CODE: ENS55**

Prices Effective Jan. 4
through Feb. 26, 1999



**ONLY
\$29.95**

Order #72-4025

TENMA® DMM with Logic Function

Features include 3½ digit
LCD display, over range
indication, 2.5 times per
second measurement rate,

logic test, frequency test, transistor test
and capacitance measurement. Input
impedance 10Mohm. Measures AC/DC to
600V, AC/DC current to 10A and more.
Includes holster, test leads and manual.
Regular price \$65.95



Multi Voltage Regulated Power Supply

**ONLY
\$16.95**

Order #28-2200

Ideal for any device drawing up to 2A.
Rotary selector switch selects 3, 4½, 6, 7½,
9 and 12V. Power projects or small battery
operated devices.

**ONLY
\$9.95**

Order
#55-1190



MCM AUDIO SELECT™

8" Polypropylene Woofer

Great for home or autosound applications.
Poly cone and rubber surround offer
excellent lows and high durability.

Specifications: •18 oz. magnet •1" voice
coil •70W/100W RMS/peak capacity
•30Hz~3.5KHz response •Qts 0.54 •Vas
2.3cu. ft. •fs 31Hz •8ohm
•**Regular price \$13.50**

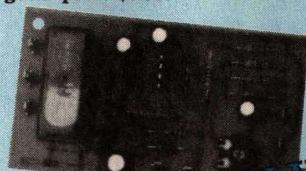


**ONLY
\$2.99**

Order #28-3475

12VDC Six Digit Counter

12VDC pulse advances electromechanical
counter by one. Mounting bracket
included for quick mounting. Dimensions:
1½"(W) x ¾"(H) x 1¼"(L).
Regular price \$3.99.



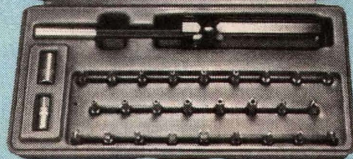
Order #28-4825

Voice Activation (VOX) Relay Module

Pre-assembled board switches output
relay when audio signal level is detected.
Input level 50mV, 10Kohm. Sensitivity
is adjusted via a board mounted
potentiometer. 5A output relay. Required
supply voltage 12VDC, 50mA. Board
dimensions 3" x 1½" x 1½".
Regular price \$17.95.

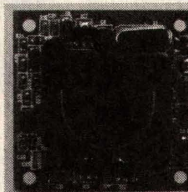
**ONLY
\$19.95**

Order #22-1475



30 Piece Security Screwdriver Insert Bit Kit

Ideal when servicing items with tamper
proof screws, such as IBM PS/2 monitors,
cable boxes, telephone equipment and
many others. Kit contains security hex,
security torx, spanners, tri-wings and
more. **Regular price \$41.25.**



Order #82-2990

DEFENDER SECURITY

Micro Board Camera

Measures only 1¼" x 1¼" x 1". Features a
⅜" CCD image device producing over 380
lines of resolution. The built-in 3.6mm
lens has a viewing angle of view of 92°.
Requires 12VDC, 330mA.
Regular price \$64.95.

**ONLY
\$49.95**



Order #72-2010

TENMA®

Laboratory Power Supply

Precision power supply is adjustable from
0~30VDC, 0~3A. Large analog meters
display voltage and current in two ranges.
Fine and coarse adjustments provide
precise setting. **Regular price \$199.00**

**ONLY
\$159**

**FREE
Catalog!**



MCM ELECTRONICS®

650 CONGRESS PARK DR.
CENTERVILLE, OH 45459
A PREMIER FARNELL Company

Same Day Shipping!

In stock orders
received by 5:00 p.m.
(YOUR TIME), are
shipped the same day.

1-800-543-4330

www.mcmelectronics.com

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

SOURCE CODE: ENS55

February 1999, Electronics Now

CALL TOLL FREE
(800) 292-7711 orders only
Se Habla Español

C&S SALES

EXCELLENCE IN SERVICE

LOOK FOR OTHER
MONTHLY SPECIALS
ON OUR WEBSITE

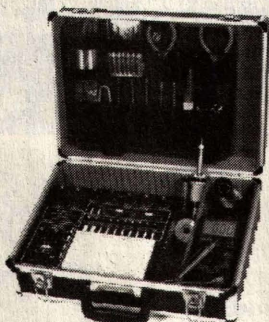
XK-700 Digital / Analog Trainer

Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled and Tested
\$189.95

XK-700 - SEMI KIT
w/ Fully Assembled PC Board
\$174.95

XK-700K - Kit
\$159.95



Made in the USA

Digital Multimeter Model M-1740

\$39.95
Free Holster

- 11 functions
- Freq to 20MHz
- Cap to 20μF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs



DIGITAL LCR METER Model LCR-1810

\$99.95



- Capacitance .1pF to 20MF
- Inductance 1μH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

15pc. VCR Service Tool Kit Model TK-1400

- Inclined Base Screwdriver
- Eccentric Screwdriver
- 2mm & 3mm Fine Adjust Screwdriver
- VHS VCR Head Puller
- Retaining Ring Remover
- 3 Reversible Screwdrivers
- Spring Hook Tool
- Micro Screwdriver
- Hex Wrench Set

Special
\$24.95



Model M-6100

The M-6100 is Elenco's most sophisticated meter with almost every possible feature available. The M-6100 even has a computer interface for viewing and storing data on a personal computer. It comes complete with software, RS-232 cable, test leads and manual.

\$99.95

Model XP-581

4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

\$89.95



Tektronix DMMs

For high performance digital multimeters that are accurate, reliable, and rugged, the DMM900 series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capabilities that span voltage, current, dual numeric display, 3 year warranty, and autoranging capability. All backed by the reliability of the Tektronix brand.



912 \$179
914 \$229
916 \$275

Power Supply Kit Model XP-720K

3 fully reg. DC supplies
1.5VDC - 15VDC @ 1A
-1.5VDC to -15VDC
5VDC @ 3A

Plus
6.3VAC @ 1A and
12.6VAC C.T. @ 1A

\$54.95

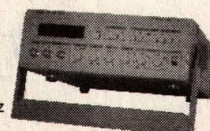


Available assembled Model XP-720 \$84.95

Sweep Function Generator with built-in Frequency counter Model GF-8026

\$225

- Range .02Hz - 2MHz
- Sine, Square, Triangle, Pulse, Ramp
- Ext. counter 1Hz - 10MHz



Kit Corner

over 100 kits available

AK-700

\$15.95

Phone kit with training course
4 Flashing neon lights
See thru case



RADIO CONTROL CAR KIT MODEL AK-870

- 7 functions
- Remote control included

\$24.95

No Soldering Required



Model AM/FM-108K Transistor Radio Kit with training course

\$29.95



Free Stand

35mm Camera Kit Learn all about photography AK-540

\$14.95



No Soldering Required

Digital Capacitance Meter Model CM-1555

\$48.95



- Capacitors from 1pF to 20M μF
- 3 1/2 Digit LCD
- Zero adjust
- special insertion jack
- 1/2% basic accuracy
- Tilt stand

Digital Audio Generator with built-in Counter SG-9300

\$175



- 10Hz - 1MHz
- Low Distortion
- Sine/Square waves
- Built-in 150MHz Frequency Counter

SG-9200 Analog/No counter \$119.95



RF Generator with Counter

Model SG-9500 \$225

- 100KHz - 150MHz
- Internal AM Mod of 1KHz
- RF Output 100MV - 35 MHz
- Audio Output 1KHz @ 1V rms

SG-9000 Analog/No counter \$119.95

WE WILL NOT BE UNDERSOLD C&S SALES, INC.

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



15 DAY MONEY BACK
GUARANTEE
FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 322 ON FREE INFORMATION CARD

**Same Day
Shipping**

C & S SALES
Your one stop source for
all your electronic needs!

CALL OR WRITE FOR OUR
**NEW FREE 64 PAGE
CATALOG!**
(800) 445-3201

Fluke Scopemeters



123 NEW \$1140
92B \$1445
96B \$1695
97 \$1695
99B NEW \$2095
105B \$2495

**ALL FLUKE
PRODUCTS
ON SALE**

B & K PRECISION SCOPES

20MHz DUAL-TRACE
Model 2120B - 2 Year Warranty

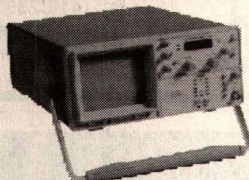
Special \$375

Model 2125A with delayed sweep
\$539.95



- 1mV/division sensitivity
- AUTONORM triggered sweep operation
- AC, TVM, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

Affordable Spectrum Analyzers by B&K



500MHz Series BK2615A \$1250
BK2620A \$1675

- 150KHz to 500MHz
- Dynamic Range 80dB(113dB with attenuation)
- +20dB maximum input
- 12.5 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2620A)

1.05GHz Series BK2625A \$1925
BK2630A \$2595

- 150KHz to 1050MHz
- Dynamic Range 80dB(113dB with attenuation)
- AM & FM demod included
- 20 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2630A)

PORTABLE SEMICONDUCTOR TESTER

B&K 510

\$199.00



- In or out-of-order circuit tests for transistor, FETs, SCRs and darlington.

20MHz Sweep / Function Generator with Freq Counter

B&K 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep



\$399

10MHz B&K 4017 \$309
5MHz B&K 4011 \$239

Quality Scopes by Elenco

Lowest Prices of the Year!



60MHz

DS-603 \$995

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

S-1360 \$749

- Analog with Delayed Sweep
- Component Tester

100MHz

S-1390 \$895

- Analog w/ delayed sweep
- Dual Time Base
- TV Sync



40MHz

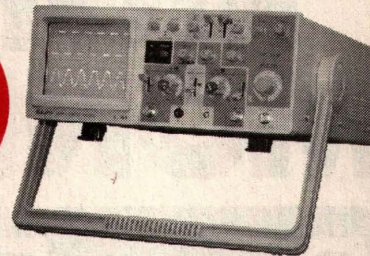
S-1345 \$569

- Analog with Delayed Sweep
- Component Tester

S-1340 \$475

- Analog / TV Sync
- 1mV Sensitivity

**2 Year
Warranty**



25/30MHz

DS-303 30MHz \$895

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

DS-203 20MHz \$695

- Analog / Digital Storage

S-1330 \$439

- 25MHz Analog
- Delayed Sweep

S-1325 \$325

- 25MHz Analog
- TV Sync
- 1mV Sensitivity

Fluke Multimeter Specials



F-73III

\$119

List
\$135



F-75II

\$129

List
\$149



F-79II

\$175

List
\$199



F-87

\$289

List
\$335

B&K Precision Multimeter Specials



- Accurately measures capacitance, resistance and inductance.
- Measures dissipation factor of capacitors and Q of inductors.
- Simultaneously displays measured value and Q or dissipation factor.
- Displays the difference between measures and reference values.

Model 878

\$219.95



- 50,000 count
- 0.025% DCV
- 0.07% ohms
- Min/Max/Avg
- True RMS, AC, or AC+DC
- 100kHz AC response
- Capacitance to 50,000µF
- Frequency, duty cycle, pulse width
- dB across 1Ω to 10kΩ
- Disturbance indicator
- Autograph, bargraph with zoom
- Sealed case, Splashproof
- IEC 1010, class 2 safety compliance

Model 5390

\$295⁰⁰

MX-9300

Four Functions in One Instrument

Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @ 2A



\$459⁹⁵

GUARANTEED LOWEST PRICES

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090

FAX: (847) 541-9904 (847) 541-0710

http://www.elenco.com/cs_sales/



**15 DAY MONEY BACK
GUARANTEE**

FULL FACTORY WARRANTY

PRICES SUBJECT TO CHANGE WITHOUT NOTICE
Most Major Credit Cards Accepted

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

CIRCLE 322 ON FREE INFORMATION CARD

February 1999, Electronics Now

67

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

RF Data Modules

AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc

- 418MHz or 433MHz
- Range up to 300ft
- CMOS/TTL data input
- 7 x 11 x 4mm !
- AM-TX1-xxx \$12.60

AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)

- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm

AM-HRR6-xxx... \$16.33

FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM

- 5V CMOS logic interface
- Fast 1mS enable
- Power saving feature
- Carrier Detect output
- BiM-xxx-F \$87.36

RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's

- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm
- CYPHERNET \$139.30

AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input

- Low current. 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm
- AM-RT5-xxx \$12.10



ABACOM
TECHNOLOGIES



tel: (416)236 3858
fax: (416)236 8866
www.abacom-tech.com
MasterCard / VISA

PIC'n Books

LEARN ABOUT PIC MICROCONTROLLERS

EASY PIC'n - Beginner

\$29.95

- Programming techniques
Instruction set, addressing modes, bit manipulation, subroutines, loops, lookup tables, interrupts
- Using a text editor, using an assembler, using MPLAB
- Timing and counting (timer 0), interfacing, I/O conversion

PIC'n Up The Pace - Intermediate

\$34.95

- Serial communication - PIC to peripheral chips and PIC-to-PIC
- Serial EEPROMS
- LCD interface and scanning keypads
- D/A and A/D conversion - several methods
- Math routines

PIC'n Techniques - Intermediate

\$34.95

- 8-pin PICs
- Timer 1, timer 2 and the capture/compare/PWM (CCP) module
- Talking to a PIC with a PC using a terminal program
- Test equipment and data logger experiments

See Table Of Contents: <http://www.sq-1.com>

+ \$4 s/h in US for 1 book, \$5 for 2 books, \$6 for 3 books
VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax
PIC and MPLAB are trademarks of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
Web Site: <http://www.sq-1.com>
E-Mail sqone@pacific.net

velleman

HSS5 HANDHELD OSCILLOSCOPE

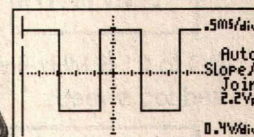
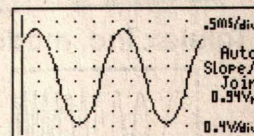
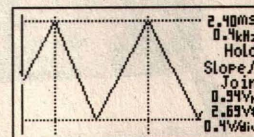
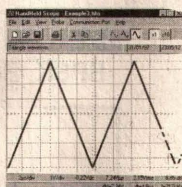
Your Ideal Tool For Service - Automotive - Education - Hobby, etc...

- Truly Handheld
- High contrast LCD screen
- Full Auto Setup (max sensitivity 5mV/div)
- True RMS, peak-to-peak, DC and dB readout (down to -74dB)
- On-screen markers for voltage, time and frequency
- Adjustable trigger level
- Triggering: normal, auto or single
- Trigger edge selection
- Screen hold function
- Waveform memory
- Built-in sine wave generator
- RS232 interface and FREE* software
- Battery pack and holster included

OPTIONS

- Carry case : BAG13X24
- Probe : PROBE20 or isolated probe : PROBE60S
- RS232-output cable+ Windows software : OPTRS232

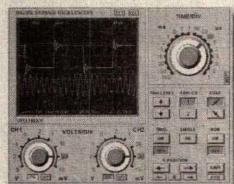
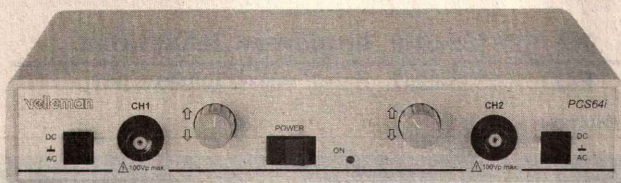
* Available from www.velleman.be



Simulated screenshots

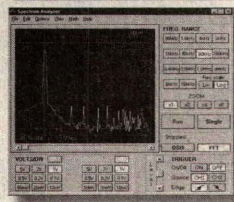
\$249

PCS64i DIGITAL OSCILLOSCOPE FOR PC



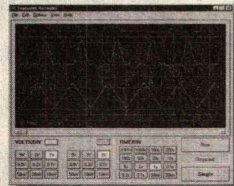
OSCILLOSCOPE [DOS-screen]

- timebase : 100ns to 100ms per division
- input sensitivity : 10mV to 5V/division
- pre-trigger function (not in 64MHz mode)
- true RMS readout (only AC component)



SPECTRUM ANALYSER [Windows-screen]

- frequency range : 0 .. 800Hz to 16MHz
- linear or logarithmic timescale
- operating principle : FFT (Fast Fourier Transform)



TRANSIENT RECORDER [Windows-screen]

- timescale : 20ms/Div to 2000s/Div
- max record time : 9.4hour/screen
- automatic storage of data
- automatic recording for more than 1 year
- record and display of screens
- data format : ASCII

OPTICALLY ISOLATED FROM COMPUTER

- Uses an IBM compatible computer and its monitor to display waveforms
- All standard oscilloscope functions are available in the DOS or Windows program supplied.
- Operation is just like a normal oscilloscope
- Markers for indicating voltage and frequency provide considerable ease of use.
- Can also be used as a spectrum analyser up to 16 MHz, and as a transient signal recorder, for recording voltage variations or for comparing two voltages over a longer period (up to more than 1 year!).
- Connection is through the computer's parallel port.
- The oscilloscope and transient recorder have two completely separated channels with a sampling frequency up to 32 MHz in real time, oversampling of 64MHz is possible in the Windows software.
- Any waveform displayed on the screen can be stored for later use.

SYSTEM REQUIREMENTS:

- IBM compatible PC
- Windows 95 or 3.11 or MS-DOS
- VGA display card (min. 800x600 for Windows) and mouse
- 480Kb free conventional memory (Dos software)

OPTIONAL ACCESSORIES

- NiCd battery pack : BP9 for battery operation
- oscilloscope probes (2x) : PROBE60S (isolated)
- carry case : BAG21X19

\$399

velleman

7415 Whitehall Street Suite 119
Fort Worth, TX 76118

(817) 284-7785 F : (817) 284-7712

www.velleman.be email : velleman@earthlink.net

Questions ? Contact us for a list of US distributors or to get your **FREE** catalogue

CIRCLE 282 ON FREE INFORMATION CARD

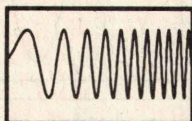
Any waveform you want!



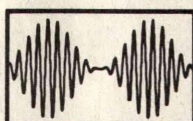
New Features:

- ✓ 21.5 MHz
- ✓ .01 Hz steps
- ✓ multi-unit phaselock

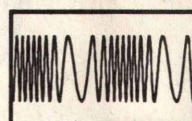
Telulex Inc. model SG-100A



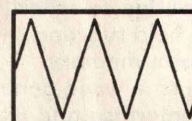
DC to 21.5 MHz linear and log sweeps



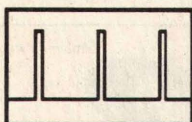
Int/Ext AM, SSB, Dualtone Gen.



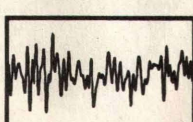
Int/Ext FM, PM, BPSK, Burst



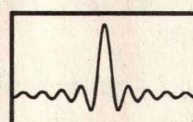
Ramps, Triangles, Exponentials



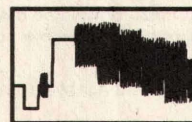
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

● Synthesized Signal Generator

Clean sinewaves DC-21.5 MHz, .001% accuracy! .01 Hz steps. DC Offset. RS232 remote control.

● Arbitrary Waveform Generator

40 Megasamples/Second. 32,768 points. 12 bit DAC

● Function Generator

Ramps, Triangles, Exponentials & more to 2 MHz!

● Pulse Generator

Digital waveforms with adjustable duty cycle

Telulex Inc.

2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>
Mountain View, CA 94043 Fax (650) 938-0241 Email: sales@Telulex.com

CIRCLE 311 ON FREE INFORMATION CARD

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775

For information regarding all of your **BASIC** cable needs.



**BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION**

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- ❖ PRICE
- ❖ EFFICIENT SALES AND SERVICE
- ❖ WE SPECIALIZE IN 5, 10 LOT PRICING
- ❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)
- ❖ **ANY SIZE** ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment **ONLY** – Don't trust last year's **OBSOLETE** and **UNSOLD** stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
*Refer to sales personnel for specifications.

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

Digital Power Meter



Measures
Watts
& Watt-hours
(kW-hr)



Simple to use.
Plug the Power Meter
into any AC outlet, and plug the
appliance to be measured into the
Power Meter. That's it!

Model 4-1850:

- Measure REAL ("true") power
1 to 1850 Watts
- Measure Power used, 1 Watt-hour
to 9999 kilo-Watt-hr
- Measure power cost (\$), just enter
cost per kilo-Watt-hr

New! Advanced model
with additional features
Irms, Vrms, Power Factor,
20 mhz processor and more!
Model 20-1850

Performs the same functions as instruments costing \$500-\$1000!
No other instrument on the market even comes close for this price!!

Model 4-1850 Only \$149.⁹⁵ Delivered!

Model 20-1850 Only \$249.⁹⁵ MC/Visa/MO/Check

Custom applications available • Dealer inquiries welcome

Brand Electronics,
421 Hilton Rd.
Whitefield, ME 04353
For information only, call 1-207-549-3401
email: ebrand@mint.net

Call today! To order, call toll free, 24 Hrs.

1-888-433-6600

<http://www.mint.net/~ebrand/>

CONTROL

RELAYS • LIGHTS • MOTORS

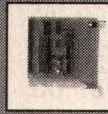
MEASURE

TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY

INPUT

SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



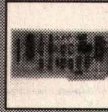
- PLOGB INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC

MODEL 45 \$189



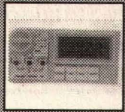
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 10K KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179



- RS-232 INTERFACE
- TEMP, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$109



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 SMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53578

CIRCLE 315 ON FREE INFORMATION CARD

Credit Card FINANCING

2 payments of
\$29 Books

2 payments of
\$29 Books
back issue, perfect for
Service & Experimenter

2 payments of
\$195 publisher

2 payments of
\$115 publisher

2 payments of
\$235 publisher

IC MASTER
97 ICM CD
2 Easy Payments of
\$75!!

2 Easy Payments Any Product

Complete
Catalogs of ALL Major
Component Manufacturers

2 payments
\$29

2 payments
\$44

2 payments
\$52

97 EEM CD
or books

98 EEM CD

96 ICM Books
for Lite Design & Service

97 ICM CD
97 for Moderate design

97 ICM Bks

98 ICM CD
for Advanced Design

2 payments of
\$75

2 payments of
\$65

2 payments of
\$99

Service Center Favorite

**SEMICONDUCTOR
CROSS
REFERENCE
& SPEC**

Quarter Million
Transistors, ICs & Diodes
with REFERENCE

A Specialist in "Hard to Cross House Numbers"

Easy, Powerful & Fast. The Most Comprehensive
Software Sold. A selection yields Device Specifications
& 75 to 250 Potential Replacements!

Replacement Numbers are Totally Global including Domestic, Asian, European, House
Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead
Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers
is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, Win3.1 & 95
Latest Version 7.11 Includes Many Helpful Conversion Utilities, Tables & Formulas.

Includes: 4 HUGE Consumer Electronics Industry Directories
1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers
3- The Entire Computer Industry 4- Semiconductor Manufacturers
Perfect for Service, Engineering and Purchasing.

2 easy payments of
\$49!

Shop the way the Pro's do, Use Their Tools!

These are the books that find the "Gold". For many years
they've been used by the Sharpest Purchasing Agents.
Look under every rock... they're impossible to find at ANY
price, let alone a great deal like this. Find: Distributors,
Manufacturers and Service providers for Products,
Services or ANY Component Parts imaginable. Sources for
Everything from Gears to Semiconductors to Foreign
Assembly Services.

1 Single Payment
\$25 **\$235** publisher

**Parts Source
Library**
Best Kept Secrets

all 6 pieces!

WOW 2 payments of
\$282!
Credit card Plan

Great Deals
2 payments of
\$282 Compaq 486 DX4-100
16m - 710m - 10.4"ds - W95 - PCMCIA

Real Beauties!
2 payments of
\$379 Compaq Pentium 90
16m - 810m - 9.4" Active - PCMCIA
may differ slightly from illustration

All Cards & COD Int'l Orders email: netcomd@aol.com
Netcom **800-733-3733 ext 6300** FAX 516-826-7776 7 Days

CIRCLE 219 ON FREE INFORMATION CARD

LASER WINDOW BOUNCE LISTENING SYSTEM

Remarkable concept allows user to hear sounds within a premise over a beam of laser light reflected from a window or similar surface. Experimental device provides hours of interesting and educational use. Utilizes a visible red laser that simplifies alignment and discourages illegal use. Usable range will vary—expect about 20 to 50 meters. Optional lens will increase range 200 to 400 meters! Further range requires expensive optics. Basic system setup requires patience in alignment and a sturdy video tripod (not incl.)



Uses Scattered and Direct Reflections

LWB5 Plans.....\$20.00 **LWB5K Kit/Plans.....\$149.95**
LWB50 Basic System Assembled and Tested.....\$199.95
LWB70 Higher Performance Version With High Coherence Laser Gun Sight, Extending Lens, Delux Headsets.....\$299.95

KINETIC ELECTRIC GUN

PIONEER A FUTURISTIC WEAPON!



500 Joules Energy Storage
 Constant Current Charging
 Triggered Spark Switch
 Ballistic Velocities
 Handheld Battery Operated

PROTOTYPED IN OUR LABS Labeled A Dangers product JOIN THE RESEARCH!

EGUN1 Plans with Parts List.....\$20.00
 All Parts are Individually Available

3 MI FM BROADCAST TELEPHONE TRANSMITTER

Tunable On FM Broadcast. Excellent Telephone Project. Only Transmits When Phone is Used

VWPM7K Kit/Plans.....\$39.95
BEEP1K Beeper Alert Kit.....\$19.95

LASERS

SUPER BRIGHT VISIBLE RED POINTERS

- *Signaling Beacon Visible Over 25 Miles!!
- *Over 1/2 Mile Pointing Range
- *Light Up a Low Level Cloud
- *Great Fun At The Mo
- *Drive The Cat Nuts!!
- *6Hrs On AAA Batteries
- *5 5/8X1/2" All Metal

LAPN65 15 mw equiv 2000ft.....\$24.95
LAPN65F Above Focussable.....\$29.95
LAPN63 30 mw equiv 4000ft.....\$49.95
LAPN63F Above Focussable.....\$54.95

PRICE SLASH LASER "LIGHT SHOW" POINTERS

- *Projects 7 Complex Light Designs
 - *Produce a Small Light Show
- LAPN65PT 640nm 7 Patterns.....\$19.95!!**

FM TRANSMITTER KITS

ALL PARTS TO BUILD 6 LONG RANGE WIRELESS DEVICES

- 1 Super Sensitive Ultra Clear 1 Mile+ Voice Transmitter
- 2 1 Mile + Telephone Transmitter
- 3 Line Powered Telephone Transmitter Never Needs Batteries!!
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Transmitter Rebroadcasts Video or Audio Outputs
- 6 Short Range TV/FM Disrupter NEAT PRANK!!! Discretion Advised

All 6 Above Kits Plus FREE Info Data Pack on HELPFUL HINTS Building and Tuning Wireless Devices

COMBOX Parts and Plans for above.....\$59.95
COMBOP Plans for all the above.....\$10.00

10-14" of Explosive Bolts of Lightning

250KV TESLA COIL

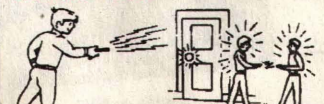
Transmit Wireless Energy Strange and Bizarre pyrotechnical effects. Ion Motors Anti-Gravity Size 20" H x 8" Sq Weight - 25 Pounds 115 Volts/2 Amps AC Labeled "Use Caution"

BTC3 Plans.....\$15.00
BTC3K Kit/Plans.....\$399.95
BTC30 Ready to Use.....\$499.95
BTC4 Plans 24 to 30" Sprk.....\$20.00

HIGH POWER STUNGUNS

STUN100 100KV StunGun.....\$19.95
STUN200 200KV StunGun.....\$39.95
STUN300 300KV StunGun.....\$49.95

ION RAY GUN PROJECTS ENERGY



Star Wars Technology Demonstrates Weapons Potential! See Ions in Motion!

IOG7/9 Plans.....\$10.00
IOG7K Kit/Plans.....\$99.95
IOG70 Assembled and Tested.....\$149.95
HIGHER POWERED DEVICE
IOG9K Kit/Plans.....\$149.95
IOG90 Assembled and Tested.....\$199.95

ATTENTION! HIGH VOLTAGE EXPERIMENTERS

Battery Powered Mini Sized Modules for research in: HOVERCRAFT, ION GUNS FORCE FIELDS, SHOCKERS
MINIMAX4 4KV@10ma.....\$19.95

GRAVITY GENERATOR

Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build and levitate a small mock space ship from simple materials. Excellent scientific demonstration of a fascinating method of levitation. **Levitate an Object!!**

GRA1 Plans and Book.....\$20.00
GRA1K Pwr Sup Kit/Plans.....\$99.95
GRA10 Assembled Pwr Sup.....\$149.95

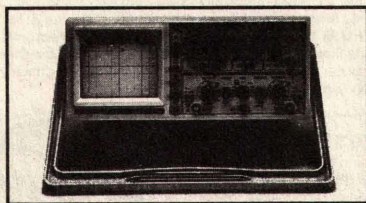
SHOCK FORCE FIELD/VEHICLE OBJECT ELECTRIFIER

Hand Shock Balls, Wands, Electrify Objects. Great Payback for Those Wiseguys!
SHK1K Kit of Pwr Module.....\$19.95

1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST
 Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

New and Pre-Owned Test Equipment

Goldstar



Model OS-5100 → \$899.00
Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer
 Avcom PSA-37D

Satellite Downlink
 Installation
 Maintenance & Service

- Band 1 10 - 1750 MHz
- Band 2 3.7 - 4.2 GHz
- Built-in DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only \$2,475.00!

We Buy Surplus
 Test Equipment

Leader CATV Signal Level Meter Model LF 941

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements **\$695.00!**

Just Released! → "Series III" Multimeters

Fluke Model 87III \$319.00 !!!

SIMCHECK® II PLUS Module Tester

- * Tests SIMMs/168 p DIMMs
 - * Stand alone/portable
 - * Identifies Module properties
 - * Advanced Setup Capabilities
- Only \$2750.00!**

(1-800-996-3837)

Pre-Owned Oscilloscope Specials

Tektronix 2213	60 MHz	\$549.00
Tektronix 2215	60 MHz	\$649.00
Tektronix 465	100 MHz	\$599.00
Tektronix 465B	100 MHz	\$729.00
Tektronix 475	200 MHz	\$829.00
Tektronix 475A	250 MHz	\$999.00

- Professionally Refurbished
- Aligned & Calibrated to Original Specifications
- The Industry Standard of Oscilloscopes
- 1 Year Warranty - The Longest Available!!!

See us on the Web!
www.fotronic.com

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176
 (781) 665-1400 • FAX (781) 665-0780

email: sales@fotronic.com



TOLL FREE 1-800-99-METER

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY
PARTS

FAST
SHIPPING

DISCOUNT
PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.
Outside the U.S.A.
send \$3.00 postage.

Mini-Right Angle Gearhead Motor with Control Circuit

Omron # R2DG-41
These unusual little
motors have built-in
control circuits that
allow them to be
used in a continuous
or a pulsed mode. In continuous mode
the final drive gear turns at 22-45 RPM (3-6
Vdc). In the pulsed mode the final drive gear
turns one revolution each time the controller is
momentarily pulsed. The motor assembly is
1.75" x 1.25" x 0.5" overall. The nylon final
gear is 0.62 diameter and has a little nipple
slightly off-center to which a small push-rod
could be attached. Motors are in good condi-
tion, removed from equipment. Hook-up
instructions included.

CAT # DCM-110 **\$7⁵⁰** each

3000 MCD ULTRA-BRIGHT RED LED

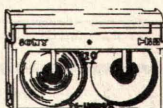
25¢ each in 1,000 Quantities

Everlight # 383URC-2/TR1-C(R)
Red, "Ultra-bright" T 1 3/4 LEDs
now at our lowest price ever.
Due to a special purchase of
"tape-and-reel" parts we are
able to offer these LEDs at an
incredibly low price when pur-
chased on the reel. These
are 5 mm diameter water-
clear LEDs that light bright red at 20 ma.

CAT# LED-50
2 for \$1⁰⁰
100 for \$35.00
1000 for \$250.00
(25¢ each)

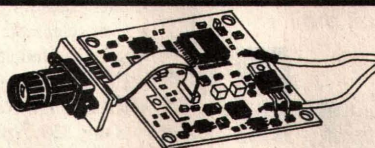
"Hi-8" Video Cassette

SONY Hi-8 Top quality,
metal particle 120 minute
video cassettes. Used
for a short time, then
bulk-erased. Each
cassette has its own
plastic storage box.



CAT # VCU-8 **\$3⁰⁰** each
10 for \$28.00 • 100 for \$250.00

Our Lowest Price Ever! COLOR, VIDEO CAMERA



Get a good quality color board-level
camera for less than black-and-white.

NTSC composite video output camera. Two
pc board design: 7 mm adjustable lens and
1/4" CCD sensor are mounted on 1.18" x 0.83"
pc board. Lens length, 1.1". Control board is
2.36" x 2" x 0.6" thick. 250,000 pixels. Focus
from 5 mm to infinity. 4' cable for power input.
5' cable with RCA plug for video output.

Operates on 5 Vdc, $\pm 5\%$, 180 mA max.
Ready to go - includes wall
transformer power supply.

CAT # VC-600

\$85⁰⁰ each

S-VHS Tape (Used)



Super VHS tape users!
Save a bundle on
name-brand S-VHS,
T-120 tapes. These
tapes were used for a
brief period, then bulk
erased. The record-
protect tabs have been
broken out, so you will have
to cover the notch with a piece of
tape, but they work great and cost a
fraction of the "new" price.

CAT #S-VHS **\$3⁰⁰** each

10 for \$28.00 • 100 for \$250.00

Encased Piezoelectric Element

0.82" DIAMETER X 0.15"

AVX/Kyocera # PCRT21BGX
Black plastic front, vented metal
back. Solder loop terminals. Louder than
non encased piezo elements. Requires exter-
nal signal to produce sound. CAT # PE-38

3 for \$1⁰⁰
100 for \$25.00
1000 for \$125.00

9 Volt Style Nickel-Cadmium Rechargeable Battery

Sanyo "Rechargacell"™ # N-6PT
7.2 v 120 mAH battery
for 9 Volt applications.

\$2⁰⁰ each
CAT# NCB-91
20 for \$30.00



STEREO HEADSET with Electret Mike

Andrea Electronics # M-150
Designed for use with
personal computers for multi-
media, speech recognition,
internet telephone, etc.

Stereo headset
and boom mike
has two separate
3.5mm stereo
plugs for connection
to mike and speaker jacks.
Lightweight headphones
with adjustable headband.
6' cord.

CAT# PHN-15

\$8⁷⁵ each

10K THERMISTOR

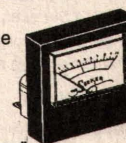
Semitec # 103AT-2
10K ohm ($\pm 1\%$) @ 25 deg. C.
Rated 10 mW. Time constant: 15 sec.
2 mm x 3mm. 2.5mm lead spacing.

\$1⁰⁰ each

CAT #THR-20
10 for \$8.50
200 for \$130.00

250 uh PANEL METER

Good-looking 1.65" x 1.68"
panel meter. Matte-black frame
with a 1.43" x 0.84" viewing
window. Scale calibrated from
1 to 10, divided into green
(1-4), yellow (4-6) and red
(6-10) areas. Logo, "The Seeker"
is written under the scale.



\$1⁵⁰ each

CAT #MET-51
10 for \$12.50

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET <http://www.allcorp.com/>
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail •
Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United
States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

February 1999, Electronics Now

Since 1971

WWW.WEB-TRONICS.COM

Circuit Specialists, Inc.

Check us last for the best deals on quality electronic parts, equipment & supplies!

- ♦ Easy to navigate site with loads of information
- ♦ Thousands of stock items
- ♦ Special deals found nowhere else
- ♦ New products added constantly
- ♦ Prices updated weekly on volatile computer products

♦ Order online, by FAX, by phone or snail mail

CCD Board Cameras & Surveillance Supplies

Printed Circuit Board Supplies

Computer Systems & Boards

Industrial Computer Products

NuDAQ DAQ Boards!

All Kinds of Do It Yourself Kits & Projects

Super Test Equipment Deals!

Cabinet & Enclosures

Switches

Passive Small Parts, Resistors, Diodes, Pots, Inductors, Capacitors,

Lamps, LEDs, etc.

I.C.s

NTE Replacement Devices

Soldering Equipment & Electronic Tools

Prototyping & Breadboard Supplies

Connectors

Cable Ties, Heat Shrink & Wiring Products

Special Kitting Service for Educators

Lasers & Educational Laser Products

and much, much more!

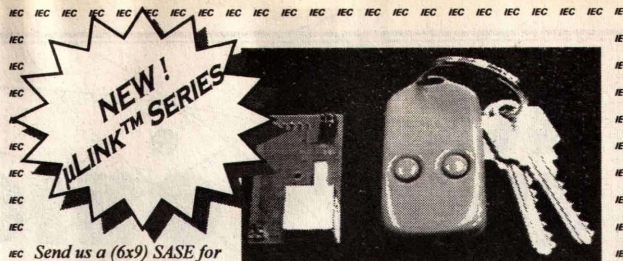
Circuit Specialists, Inc.

800-811-5203

FAX 602-464-5824



You'll
"Bookmark"
This Site!



Send us a (6x9) SASE for
your FREE catalog.

μLink™ Infrared Remote Control System

- 4 Channel IR Keychain Transmitter (pcb 1.1" x 1.2") IRTX4-A
- 4 Channel IR Receiver (pcb 1.1" x 1.9") IRRX4-A
- Each receiver can LEARN up to 4 transmitters.
- Each transmitter can have a different access level.
- User selectable receiver output modes.
- Security, Industrial and Home Control Applications
- Up to 9m Range.
- RX and TX IC's available. Custom design service available.

Only \$39.⁹⁵/pair + S&H, additional IRTX4-A units \$19.⁹⁵

SURFACE MOUNT KITS:

- Pager Decoder Interface
- Garage Door Openers

- PLL XTAL FM MIC
- LC tuned FM MIC
- Phone transmitters

Orders: 1-800-417-6689 Mon-Fri 9AM-6PM ET

visa/mastercard/money orders

email: iecorp@i-e-c.com

web: www.irmicrolink.com

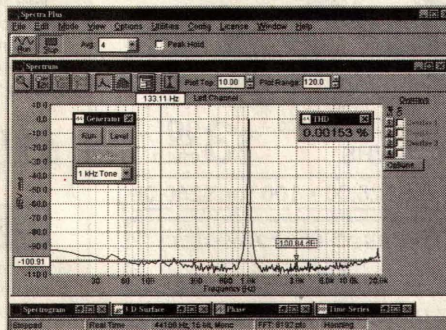
IEC ♦ PO Box 52347 ♦ Knoxville TN 37950

COPYRIGHT ©1998 International Electronics Corp.

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

Priced from \$299

(U.S. sales only – not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

PHS

Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472

Fax: (360) 697-7717



Spectra Plus
FFT Spectral Analysis System

e-mail: pioneer@telebyte.com

!!! BROADCAST EQUIPMENT !!!

We manufacture & carry Stereo FM Transmitters, RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing Boards & Consoles, Mics, Compressor/Limiters, Digital Reverbs, Automation Software, RF Test Equipment, RF Parts including 8GY133's, and much more! Call For Free Catalog.

Progressive Concepts
BOX 586 STREAMWOOD, IL 60107
(630) 736-9822 FAX (630) 736-0353

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call C&D ELECTRONICS

1-888-615-5757 M-F 10a-6p

New!

Low Cost, Precision-Made
PC BOARDS
From Your Gerber/NC Drill Files



www.pcbmilling.com

FAX: (703) 818-0071

ULTIMATE HOME SHOP

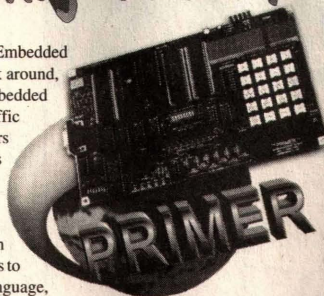
Complete tools for metal & woodworking



Call! 1-800-345-6342 or write to **Smithy** Dept. ENS P.O. Box 1517 Ann Arbor, MI 48106-1517

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. **So don't be left behind; this is information you need to know!**



Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1998
OVER
12
YEARS
OF SERVICE

Learn to Hack!

The Happy Hacker

NEW 2nd EDITION!

Finally, here is a non-sense technical book on computer hacking! In it you will learn how to hack computers you have physical access to and how to hack on the Internet. With this book, you will learn about:

Finding computers to hack
Breaking into computers
Hacking with Finger
Port surfing
Mapping the internet
Forging E-mail
Fighting spam
E-mail bombs
Hacker wars

and more! But this book will also teach you how to hack safely. It will steer you clear of the law, so that your hacking career won't lead to prison, but to a better job! **By far, the best book on hacking available today!**

400 PAGE PAPERBACK, \$34.95 SHIPPING \$3

Call (800)719-4957 now!

to order (Visa/MC/COD) or call or write for **FREE CATALOG** of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

Check our web site: www.logoplex.com/resources/ameagle
American Eagle Publications, Inc.
P. O. Box 1507, Dept E.
Show Low, AZ 85902

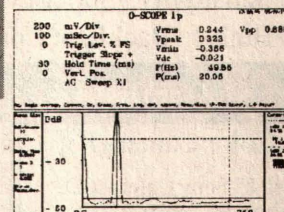
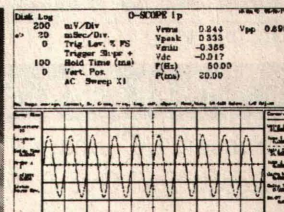
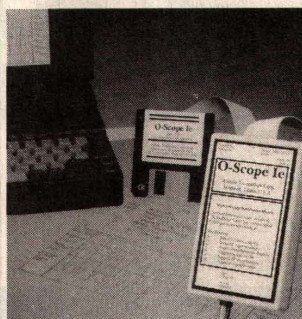
CIRCLE 270 ON FREE INFORMATION CARD

DIGITAL STORAGE OSCILLOSCOPES

WITH
SPECTRUM
ANALYZER,
DVM, FREQ.
COUNTER,
AND DATA
LOGGER.

from
\$189.

**PORTABLE
MODULES
CONVERT PC'S
INTO
MULTIPURPOSE
TEST AND
MEASURING
INSTRUMENTS.**



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:

- ♦ PORTABLE UNITS TO 25 MHz
- ♦ USES PRINTER PORT
- ♦ USES STD. PROBES

OPTIONS:

- ♦ PROBE SETS
- ♦ AUTOMOTIVE PROBES
- ♦ BATTERY PACKS
- ♦ SOFT & HARD CASES

O-Scopes Made in U.S.A.

Picos Made in U.K.

Same Day Shipping
Includes Cable, Software & Manuals

O-Scope Ip (DC-50KHz, single trace)\$189.
O-Scope II (DC-500KHz, dual trace)\$349.
PICO (ADC 200/20) (DC-10MHz, dual trace)\$349.
PICO (ADC 200/50) (DC-25MHz, dual trace) CALL
PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50(Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK,OR CALL

1-800-980-9806

Allison Technology Corporation

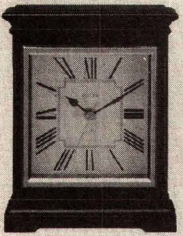
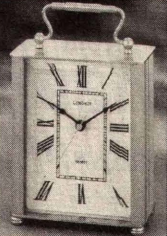
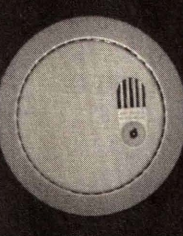
2006 FINNEY-VALLET, ROSENBERG, TX 77471
PHONE: 281-239-8500 FAX: 281-239-8006

<http://www.atcweb.com>

Source Code: 902EN

Sale Ends: 2/15/99

www.spysite.com**COVERT SURVEILLANCE: Protect Your Assets**

				EXIT SIGN CAMERA EX-985 \$295
MC-985 \$350	CL-985 \$350	SD-985 \$295	VL-985 \$350	EMERGENCY LIGHT CAMERA EL-985 \$325

All "985" Series Color Cameras Feature:

- Sensor: 1/3" Sharp® Color CCD
- Resolution: Over 380 TV lines
- Sensitivity: Super Low, 2 Lux
- Built-In Backlight Compensation
- Lens: 3.7 mm Pinhole
- Viewing Angle: 92 FOV
- Video Output: Female RCA
- Power: 5V DC (included)

CLOSEOUT**Color Camera Kit:**

- 1/2" Sony Color CCD
 - 400 TV line Res.
 - 2 lux Sensitivity
 - Backlight Compensation
 - 4 mm Standard Lens
 - Wall Mounting Kit
 - 5V Power Transformer
- SONY-1002 \$175**

Counter Surveillance: Protect Your Privacy**Protect Yourself From:**

- Telephone Taps
- Room Transmitters
- Body Wires



Built-In White Noise Generator

AI-5500 \$380**Detects Concealed:**

- Tape Recorders
- Video Cameras
- Body Transmitters
- Room Transmitters



LED and Vibration Alert

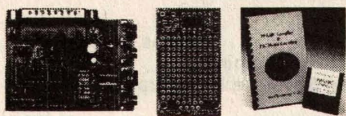
TRVD-900 \$495

Your Payment Options: Credit Card, Cashier's Check, or Money Order

AMERICAN INNOVATIONS, Inc.

119 ROCKLAND CENTER ~ Suite 315 NANUET, NY 10954
 Voice: (1)914-735-6127 Fax: (1)914-735-3560

CIRCLE 218 ON FREE INFORMATION CARD

Low Cost PICmicro Tools

- EPIC Pocket PIC Programmer - \$59.95**
 ♦ Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x
- PICProto Boards - \$8.95 to \$17.95**
- PicBasic Compiler - \$99.95**
- new! PicBasic Pro Compiler - \$249.95**
- BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.
- ♦ Expanded BS1/2 compatible instruction set
 - ♦ True compiler provides faster program execution and longer programs than BASIC interpreters

microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933
 (719) 520-5323 fax (719) 520-1867
 http://www.melabs.com

MICROTEST INC. CABLE TEST CHIPS FROM \$9.95

WE STOCK A COMPLETE LINE OF CHIPS
 WE ALSO HAVE CRYSTAL 119.MHZ2117.MHZ

WARNING...

ANYONE IMPLYING ILLEGAL USE WILL BE DENIED SALE. WE SELL PRODUCTS ONLY TO TECHNICIAN OR REPAIR FACILITIES ALL ORDERS SHIP VIA UPS/ECT THE BEST PRICE IN THE MARKET WE INCLUDE SWITCH & RESISTOR MON-SAT 8 AM-7 PM EST. TECH SUPPORT E-MAIL WWW.MICRO-TEST@AOL.COM



FOR ORDERS
1-800-931-9440

Thanks to you, all sorts

of everyday products are

being made from the paper,

plastic, metal and glass that

you've been recycling.

But to keep recycling

working to help protect the

environment, you need to

buy those products.

BUY RECYCLED.**AND SAVE.**

So look for products made

from recycled materials, and

buy them. It would mean the

world to all of us.

For a free brochure, write

Buy Recycled, Environmental

Defense Fund, 257 Park Ave.

South, New York, NY 10010,

or call 1-800-CALL-EDF.

ENVIRONMENTAL
DEFENSE
FUNDA Public Service of
This Publication

SEPA

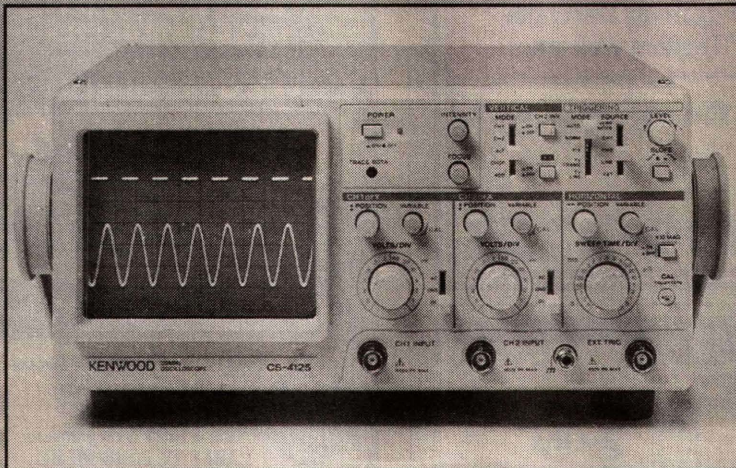
**BE A TEACHER.
BE A HERO.**

Call
 1-800-45-TEACH.

Ad Council
 A Public Service of
 This Publication

KENWOOD

*...from the company you've
been listening to for years...*

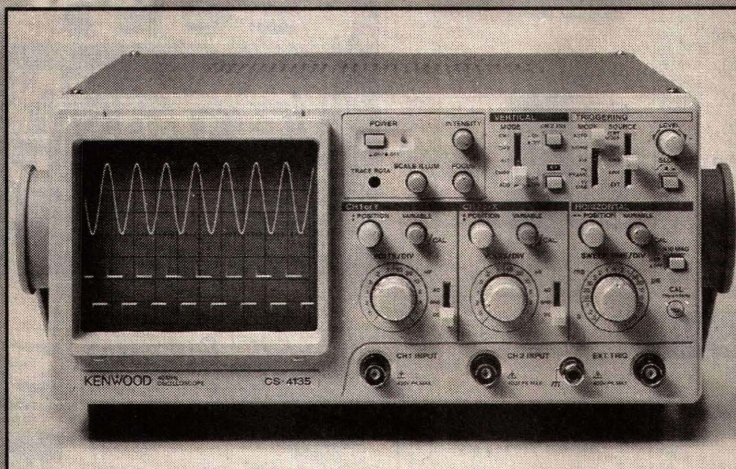


2-Channel, 20-MHz

CS-4125

Regular \$595

Sale \$389



2-Channel, 40-MHz Oscilloscope

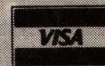
CS-4135

Regular \$855

Sale \$685

Hybrid IC Technology is the Key to the High Quality and High Reliability at Low Cost!

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm () including protrusion.
WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



PRINTTM
Products International

Call for your free 84 page test instrument catalog today!!!

*8931 Brookville Road * Silver Spring, Maryland * 20910*

** Phone 800-638-2020 * Fax 800-545-0058 * www.prodintl.com*

February 1999, Electronics Now

77

Interactive catalog: www.tekview.com

TV cable

CONVERTERS & EQUIPMENT

Clearview Group



* 30 days money back guarantee
* 1 yr warranty
* Quantity Discounts
* Dealers Welcome!

VISA MC AMEX C.O.D.

(800)739-2253

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

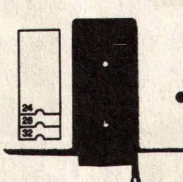
Fast - Programs 27C010 in 23 seconds
Portable - Connects to PC Parallel Port
Versatile - Programs 2716-080 plus EE and Flash (28F,29C) to 32 pins
Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters	
EP-PIC (16C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC64 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC711D3)	\$39.95
EP-16 (16bit 40pin EPROMs)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (ICT22v10, 18v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

M2L Electronics
970/259-0555 Fax: 970/259-0777
361 S Camino Del Rio Suite #119, Durango, CO 81301; CO orders add 7% sales tax.
<http://www.m2l.com>



BEST DEALER PRICING!

CABLE DIRECT

CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

FREE CABLE TV CATALOG!

100% MONEY BACK GUARANTEE!

Now you can tune-in your favorite cable TV programming and **SAVE \$100'S - EVEN \$1000'S** on premium CABLE TV EQUIPMENT.

30 DAY FREE TRIAL!

VISA MC AMEX

MODERN ELECTRONICS

1-800-906-6664

2609 S. 156TH CIRCLE • OMAHA, NE 68130
<http://www.modernelectronics.com>

Hexapod Walker Kit \$150.00 Plus S&H



lynxmotion

You can build this Hexapod Robot

This easy to build robot really walks using an alternating tripod gait. It can walk forward, reverse, and turn on a dime, left or right. With a payload of more than 12 oz., this robot is a real workhorse. The robot is programmed using simple BASIC instructions. It makes an excellent foundation for many simple and advanced robot experiments. The kit includes all the hardware, structural components, Hitec servos, First Step Micro kit, software, and an illustrated assembly manual. The Lynxmotion Hexapod Walker is a lot of fun to build and even more fun to operate.

Shown with the IRPD, no contact obstacle detector.

We have many more cool robots, check out our web page or ask for our free catalog!

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403
www.lynxmotion.com

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

MasterCard VISA

FOR 26 EASY
WAYS TO HELP
SAVE THE
EARTH CALL
1-800-488-8887.

VIDEO SYNC GENERATOR



Restores Horizontal and Vertical Sync Lines from Distorted Video

Lost Sync

Restored Sync with VSG

For Free Information Package and Pricing

Call (219) 233-3053
www.south-bend.net/rcd

R.C. Distributing, P.O. Box 552, South Bend, IN 46624

CABLE EQUIPMENT

LOW, LOW WHOLESALE PRICES!

1-800-521-0512

New 1-piece Jerrold-5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.
New RFT-M - 5 units \$109/ea; 10 u. \$99/ea; 20 u. \$89/ea.
Basic Converter - 5 units \$75/ea; 10 u. \$65/ea; 20 u. \$55/ea.

WHOLESALE ELECTRONICS
Check out our website: www.whe.net

Solar panels, Windmills, Hydro-Electric

Send today for our newly designed catalog, full of products, lots of pictures. Packed with solar, wind, hydro, pumps, kits, projects, generators, water heating, info packages, videos and much more. All for only five dollars (\$5) and its refundable with your first order.

Send \$5 to: SUN PRODUCTS
656C N. Wellwood Ave Suite 140H
Lindenhurst, NY 11757
Or Call 516-226-7846, 24 hours a day (The Solar Racer Model Kit)



BUGGED??

SAVEDROPPING is unbelievably widespread! Electronic Devices with amazing capabilities can be monitoring your telephone and room conversations RIGHT NOW! Are you sure you're safe? **FREE CATALOG** tells you fast! Includes Free Bonus details on fantastic opportunities now open in Counter-Surveillance field. Exciting, immensely interesting and EXTREMELY profitable (up to \$250 hr) full/part-time income. Call Now!

1-800-732-5000

SINGERS! REMOVE VOCALS

Unlimited, Low Cost, Instantly Available Background Music from Original Standard Recordings! Does Everything Karaoke does... Better and gives you the Thompson Vocal Eliminator! Free Brochure & Demo Tape.

LT Sound Dept EN
7988 LT Parkway, Lithonia, GA 30058
Internet: <http://www.LTSound.com>
24 Hour Demo/Info Request Line (770)482-2485 - Ext 72
When You Want Something Better Than Karaoke!



SURVEILLANCE

The Latest High Tech Professional Electronic Devices

Our latest catalog offers a HUGE selection of surveillance, counter-surveillance/privacy devices: **pinhole camera \$129⁰⁰**, hidden video, **"realtime" 12-Hour telephone recorder \$139⁰⁰**, 12 hour VOX recorder phone call register, scanners, bug/phone tap detectors, voice disguisers, locksmithing tools, vehicle tracking, wireless video, and much more. Wholesale/retail.

We will not be undersold.

Catalog \$5.00 or
www.spyoutlet.com

SPY OUTLET

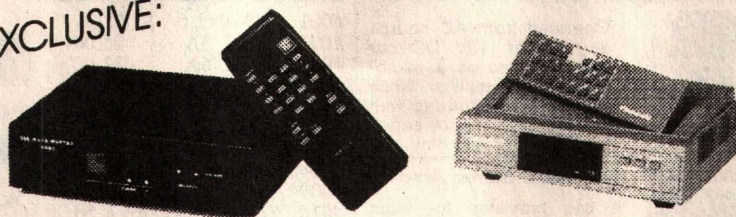
PO Box 337, Buffalo NY 14226
(716) 691-3476/(716) 695-8660

ATTENTION DEALERS: WHOLESALE ONLY!



**BEST PRICES!
FAST SERVICE
SAME DAY SHIPPING**

EXCLUSIVE:



2 PIECE SETUPS: \$85⁰⁰

10 lot • 1 Year Warranty

**Latest Technology • Universal Combo's - Ask For Details
CALL US LAST! LOWEST PRICES GUARANTEED!**

**TOLL FREE:
800-375-3682**



**FAX:
516-246-5634**

**ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM**

HP 54501A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANS. IMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SCOPMETER	\$550.00
HP 5370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3586C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR&CABLE	\$500.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC. ANALYZER	\$3500.00
HP 3437A 3-DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3456A DIGITAL MULTIMETER	\$400.00	TEK 11401A 500MHZ PROG. O-SCOPE FRAME	\$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 785A 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7S12 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A. POWER SUPPLY OPT. J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT. J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

**PRINT YOUR OWN CIRCUITS
TURN ANY ORDINARY PAPER
INTO A HIGH QUALITY TONER
TRANSFER. Join over 5,000
satisfied customers
www.starletsystems.com /now/**

CABLE TV CONVERTERS
Equipment & Accessories
Wholesalers Welcome
Call C&D ELECTRONICS
1-888-615-5757 M-F 10a-6p

**Hand-held Oscilloscope
with True RMS DMM
capabilities
for just
\$349.⁹⁵!**

**440 Scope
Plus!**

TPI



**The TPI
440 offers two
instruments in one!**

- View industrial signals such as motor control, UPS, switching power supplies, and PLC controls with 1 MHz bandwidth.
- Capture noise spikes, glitches and those evasive intermittents with 25 Megasamples per second sampling rate.
- Automatically determines correct vertical and horizontal settings to provide optimum waveform viewing.
- Don't miss a beat – the LCD display is continually updated to provide a live presentation of measurement information.
- Easy setup with Help Text. With the push of a button the 440 will help you setup the instrument for a function.
- Full autoranging DMM capabilities with built-in True RMS, 4000 count DMM.

**UL Listed! The TPI 133 is Safe,
Versatile and Affordable!**

- Safe! UL Listed. Meets CE and IEC 1010 Safety Standards.
- Measures AC/DC Volts, AC/DC Amps, Diodes, Resistance and Continuity.
- Easy-to-read, 2000 count LCD, and Data Hold.
- 3 Year Limited Warranty.



TPI 133 just \$49.⁹⁵!

J-TRON INC.
Industrial Electronic Distributors
163 Outwater Lane • Garfield, NJ 07026
Tel: (888) 595-8766 • Fax: (973) 478-8708

Mark V Electronics, Inc.

8019 E Slauson Ave
Montebello CA 90640

Free Catalog 323/ 888-8988
Fax 323/ 888-6868

DIY Audio Electronic Kits Enclosures & Transformers more than 60 items available!

http://www.mark5co.com Email: mark5co@aol.com
ORDER 1-800-521-MARK / 1-800-423-FIVE

Metal Cabinets Aluminium Front Panel

Best Buy

LG-1273	3x12x6 3/4"	\$ 26.50
LG-1684	4x16x8"	32.50
LG-1924	4x19x11 1/2"	38.25
LG-1925	5x19x11 1/2"	42.00
LG-1983	2 1/2x19x8"	35.25
LG-1923	3x19x11 1/2"	36.50
LG-1927	7x19x11 1/2"	50.50
LG- Black anodized rack cabinet		

LL-1923B 2 3/4x19x12" \$ 69.50
LL-1925A 5x19x12" 79.50

*LL-Full Aluminum, Front .157" & other .078"
*LL-Gold plated cap screw for front panel

3 1/2" Digital LED Panel Meter #TY-43

It is a precision A/D converter integrated circuit. The display is a 6" LED for high visibility. It is easy to assemble and use the meter as a voltmeter, ammeter, ohmmeter, thermometer, frequency counter or capacitance meter. DC ± 199.9 mV full scale input 5-6VDC.

Kit: \$ 28.00 15.00

20 Color LED Audio Level Meter #TY-13

Use this dual LED display indicating meter with your stereo power amplifier to indicate instantaneous speaker power. Operating range is -30dB to +5dB & can be calibrated to operate with 1-200W amplifiers. Not consume any amplifier power. A peak LED illuminates on overload!

Kit: \$ 28.50 9.99

Fluorescent Light Driver #TY-2

This unit drives 6-40 watts fluorescent light for portable & emergency use. Works from a 7.2-16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights

9.99
Kit: \$ 78.75

40W Mini Stereo Multi-Input Amp #TA-83

Operated from AC source as well as 12V DC car battery. Used as a microphone PA amplifier while simultaneously mixing with an auxiliary input source such as CD & MD player.

Kit: \$ 30.50 24.40

300W MOSFET Power Mono Amp #AF-3

300W RMS into 4 ohms, 200W RMS into 8 ohms. Frequency response: 10Hz-20KHz THD < 0.03%. S/N 91 dB. Input Sensitivity & Load impedance at 1KHz, 1V 47K & 4-16 ohm. Power Requirement: $\pm 55V$ - $\pm 65V$ DC at 8A (each channel). A speaker protection circuit which provides time delayed speaker turn on.

132.00
Kit: \$ 165.00

120W + 120W Pre & Main Stereo Amp

It has provision for input program source switching, a phono pre-amp stage with RIAA equalization, 3-band tone controls, built-in power supply rectifier & filter & a speaker protection circuit. It only needs to be installed in a suitable housing & the addition of a power transformer in order to make it operational #TA-800MK2

57.73
Kit: \$ 67.92
Asmb.: \$ 86.95

Power Transformer Toroidal Transformers

#001	28/30Vx2 6A	\$ 30.00
#002	36Vx2 3A	25.00
#003	40Vx2 6A	32.00
#004	24Vx2 6A	25.00
#005	26Vx2 3A	19.00
#006	18Vx2 5A	19.00
#007	53Vx2 8A	47.00
#008*	28/30Vx2 6A	40.00
#009*	48/53Vx2 8A	66.00
#010	30/36Vx2 400mA	8.50
#011*	9Vx2 22A	62.00
#012*	33/42Vx2 6A	48.00



Transformer



*Toroidal Transformer

150 Mhz 8 Digit Frequency Counter

#SM-100



Kit \$ 79.00 68.00
Asmb \$ 99.00

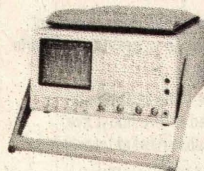
It is used for adjustment, test & repair of any kind of high frequency circuit products. It can give up to 8 digit of resolution for a wide frequency range 10Hz -150 MHz. The last input frequency can HOLD on the display for future reference & comparison. The circuit structure is compact & reliable for the most updated A/D LSI circuitry. The input impedance is 1M ohm.

We accept Visa, MasterCard, Discover & Money Orders. Checks allow 2 weeks for clearance. We ship by UPS ground inside US (min \$5.00) and ship by US mail outside US. Please call for orders shipping & handling or fax (foreign) orders. In business since 1985.

Project Kits Source...

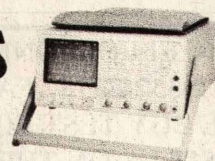
#TA-120	36W Class A Power Mono Amp	\$ 32.50
#TA-388	FET Class A Stereo Pre-Amp	64.00
#TY-25	Stereo Loudspeaker Protector	16.75
#KA-905	75-in-one Lab Kit	24.99

CIRCLE 325 ON FREE INFORMATION CARD



Test Equipment Sales

Check out our New Year's specials!



HP 8590A SPECTRUM ANALYZER.....	\$4295
HP 3325A-002 SIG.GENERATOR.....	\$1495
HP 11692D DIRECTIONAL COUPLER.....	\$395
HP 3585A SPECTRUM ANALYZER.....	\$5995
TEK SG503 LEVELED SINE GENERATOR...	\$525
TEK 2246 100 MHz 4CH. SCOPE.....	\$1295
TEK 465 100MHz 2 CH. SCOPE.....	\$400
TEK PS5010 TRIPLE OUTPUT PS. P/I.....	\$695
ROD-L M100AVS4 HIPOT TESTER.....	\$475
BMI G-111 CARD FOR 4800.....	\$195
FLUKE 752A REFERENCE DIVIDER.....	\$1895

FLUKE 5440B DC VOLTAGE STD.....	\$1795
AR 4040AT HIPOT TESTER.....	\$650
HP 1651A LOGIC ANALYZER.....	\$1295
HP 3488A SWITCH CONTROL UNIT...	\$795
GR 1657 RLC BRIDGE.....	\$695
HP 16515A 1 GHz TIMING CARD.....	\$1195
AR 5060AT HIPOT TESTER.....	\$650
HP 3478A DIGITAL MULTIMETER.....	\$650
FLUKE 343A DC VOLTAGE STD.....	\$750
WAYNE-KERR 4250 LCR METER.....	\$1295
WAV 801 50 MHz PULSE GEN.....	\$575



Ask about our line of new products including
HP, LeCroy, Instek, Tektronix, Fluke and more!



CALL 800 684-4651 OR FAX (603) 425-2945

CHECK US OUT AT WWW.TESALES.COM

RAMSEY



World's Smallest TV Transmitters

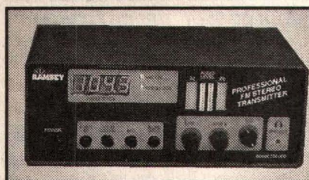
We call them the 'Cubes'... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies - that's a nickel in the picture!



Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

- C-2000, Basic Video Transmitter Cube.....\$89.95
- C-3000, Basic Video and Audio Transmitter Cube.....\$149.95
- C-2001, High Power Video Transmitter Cube.....\$179.95
- C-3001, High Power Video and Audio Transmitter Cube.....\$229.95

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require

a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - with over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

- FM-100, Professional FM Stereo Transmitter Kit.....\$299.95
- FM-100WT, Fully Wired High Power FM Transmitter.....\$429.95

AM Band Radio Transmitter



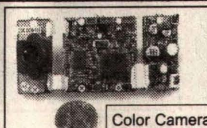
Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

- AM-25, Professional AM Transmitter Kit.....\$129.95
- AM-1, Entry level AM Radio Transmitter Kit.....\$29.95
- CAM, Matching Case Set for AM-1.....\$14.95

CCD Video Cameras



B&W Camera



Color Camera

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

- CCDWA-2, B&W CCD Camera, wide-angle lens.....\$99.95
- CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$99.95
- CCDPH-2, Color CCD Camera, wide-angle lens.....\$149.95
- IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
- IB-1, Interface Board Kit.....\$24.95

FM Stereo Radio Transmitters



Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio

quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

- FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.



- FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95
- CFM, Matching Case and Antenna Set.....\$14.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

- LPA-1, Power Booster Amplifier Kit.....\$39.95
- CLPA, Matching Case Set for LPA-1 Kit.....\$14.95
- LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95



Treasure Finder Kit

Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object.

Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

- TF-1, Treasure Finder Kit.....\$39.95

Binocular Special

We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight



aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for \$30 more!

- BNO-1, Binoculars and case.....\$24.95
- BNO-1EX, Ruby Coated Lens Binoculars and case.....\$29.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems,



hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

- SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95
- CS, Custom Matching Case and Knob Set.....\$14.95
- SS-70AWT, Fully Wired SS-70A with Case.....\$79.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

Call for our Free Catalog !

See our complete catalog and order on-line with our secure server at:

www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, order status at this number

Technical Info, Order Status
Call Factory direct: 716-924-4560

Fax: 716-924-4555



ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

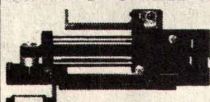
THE QUALITY YOU DESERVE

900 MHz @FIFTY Watts!, RF POWER AMPLIFIER, MICROWAVE PWR. DEVICES, CPA9093



Beautifully constructed commercial grade CDPD system amp. 0dbm input for full output. Maximum output is adjustable in 4db steps from 19dbm to 47dbm. (3 bit TTL control). 26VDC @ 7A max. power. Built on a finned heat sink 11" x 5". Overall height is 2.5". VSWR in = 1.5:1, VSWR out = 1.8:1. TTL Bias ON-OFF control, Internal reflected and forward pwr detector analog outputs. Auto thermal overload protection with TTL signal. 10CFM Air flow required at full output. SMA input connector with N type output. Aluminum cover removed for photo. **Special...\$129 2 for \$199**

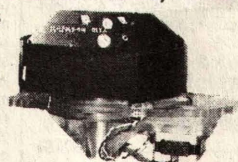
MINI MOTORIZED MOUNTS, ROTARY and LINEAR, The mini



slide (shown left) provides 2.4" of travel for its 1" x 1" alum. plate riding on two 0.18" diam steel rods. Motion is via a toothed belt drive from a 1.8° per step, 8 ohm stepper motor. 1 full step ~ about 0.008" of travel. Overall size: 6"L x 3.5"W x 2.5"H. Dual optical end of travel sensors. Aluminum construction. **Special\$29ea. or 4/\$99**

The MINI ROTARY DRIVE with on board LINEAR SLIDE, Provides

300° rotation between removable stop. Rotates continuously without stop. 2 optical position sensors for start & end. Same stepper as above. Each full step = ~0.25° of rotation. Made from cast & machined resin & alum. Attached slide provides 3" travel. Construction similar to slide above. Moves 0.008" per step. Dual optical end of travel sensors. Overall 7.5"L x 5.25"W x 4.5"H. **Special \$59ea or 2/\$99**



PELTIER, THERMO-ELECTRIC COOLERS with Fan and Heatsink, Super cooler brand air to air and air to surface units. Operate from 12VDC and provides ~20Watts of cooling or about 15deg. F differential for the air to air and about >20deg. F differential for the air to surface.



The air to air unit has two brushless fans one for heat removal and one for cool air circulation. The air to surface unit has one brushless fan for heat removal and an aluminum cold plate. The overall size of the air unit is: 4"L x 5.2"H x 2.6"W The surface unit is: 3.75"L x 3"H x 2.3"W Removed from equipment. Excellent condition. All black anodized alum. construction.



SPECIAL...AIR to AIR \$9 or Air to SURFACE \$39

FOR THOSE WHO SEEK POWER....

6V @ 12 AH SEALED, RECHARGEABLE, LEAD ACID BATTERY



Brand new Panasonic type LCR6V12PI, tough to get at a discount. Very compact. Use two for a 12V @ 12AH pack. Two top mounted 1/4" faston connectors. Perfect for robotics and other high drain applications. Size: 5.9"L x 3.7"H x 1.97"D **REG. \$18ea. NOW 2 for \$20, or 10/\$89**

10V @ 2.5 AH SEALED, LEAD ACID, PACK Each pack consists of

five, 2 Volt cells. Each cell the size of a std. 'D' battery. Arranged as 1X5 cells. Enclosed in an ABS outer shell (removed for photo) Mint condition. Perfect for high drain and robotics applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D **5-five packs\$20, 30 for \$99**



YOU CAN NEVER BE TOO THIN

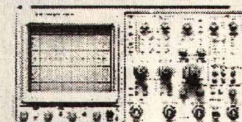
or TOO POWERFUL. Unique "Thinline Energy Cell from Portable Energy Products. Their model PLA02V50. Super thin, high performance, patented technology. RECHARGEABLE sealed lead acid battery. Each cell is 2V@5AH. Size an amazing 3.1" x 5.3" x 0.3" thick! Mount in any orientation. Line the bottom of a briefcase or covertly wear on the body. 30% higher energy density than conventional lead acid batteries. **SPECIAL 6 cells \$15 or 24 for \$49**



TEK 2465A/DM, 350 MHz, 4Chan. O'scope with DMM

Super 350 MHz four-channel scope. Sens: 2 mV at 350MHz. Risettime 1ns.

Sweep: 500ps/Div. Voltage & Time cursors, screen readout. 1 Mohm /50-ohm input. Digitize, store and recall waveforms. Auto Setup, Sequencing & more. Accessories: 10X Probes (2), Pouch, Ops Manual, Cover. Opt.01 = Digital Multimeter. Option 09 = Counter/Timer/Trigger and Word Recognizer. Mint. **TEKTRONIX 2465A/DM..... \$2695**



LENGTHLY LINEAR SLIDE, CAN GIVE YOU A LIFT as WELL !

Four different lengths available, all with similar construction. All units based on a heavy duty 1.5" wide, stainless steel, dual rails. Drive is via a toothed belt, powered by a SLO-SYN M061-LF-504, 1.25V

@3.8A stepper motor with 200 steps per rev and 60 oz. in.

hold. The "Medium unit" shown right, also includes a precise Z



axis drive, providing 3.5 inches of precise travel by virtue of its' 4:1 ratio toothed belt drive. Powered is by another M061-LF-504 stepper. The remaining three lengths have no Z drive. All units incorporate a superior quality, recirculating ball bearing slide with 3" x 3" x 1/2" thick mounting plate. "Z" unit size: 7"H x 2.5"W x 5.75D Very limited quantity. Also the "short" slide is mounted on a 1/4" thick anodized alum. plate. All have been carefully removed for precision optical equipment. The dimensions and travels are listed below:

Model	Travel	Rail L"	Weight	Overall Size	PRICE
Ex Long:	46"	49"	12lbs.	51"L x 5"W x 3.5"H	\$149ea. or \$269 for pair.
Long:	30"	33"	9lbs.	39"L x 5"W x 3.5"H	\$129ea. or \$229 for pair.
Med.w/Z:	20"	23"	12lbs.	24"L x 2"W x 4.6"H	\$139ea. or \$249 for pair.
Short:	11.5"	16"	7lbs.	16"L x 4"W x 6.5"H	\$69ea. or \$119 for pair.

ROTARY TABLE OFFERS PRECISE <0.02 deg. RESOLUTION

Hard to find rotary motion base. This 13lb. unit includes a 9.25" diameter anodized aluminum platter with a toothed outside diameter. A toothed belt surrounds the O.D. and is driven by a 1/2" diam. toothed pulley attached to the output of a Bayside 5:1 ratio, right angle drive, powered by a Slosyn, M061-LF-504, 1.25V, 3.8A, 200 step per rev., 60 oz/in. stepper motor. By our estimate this should equate to about an 18500:1 final drive ratio! or about 0.0195 deg. per full step! Overall size is: 14.5"W x 17"L x 4.75"H Constnction is of anodized aluminum with a cast structural resin outer chassis. Removed from precision optical device. **\$229ea. or 2 for \$399.**



Exclusive "LAB STYLE" LASERS, 650nm or 635nm, class 3A,

Rugged and dependable. 1 year warranty. Adjustable X & Y beam position. Aircraft aluminum housing. Internal battery (included) rear push on, push off switch. AR coated end window. 75diam. x 2.75"L **650nm \$69 or 635nm \$99**



PLANTRONICS "SPIRIT" BOOM MIC HEADSET

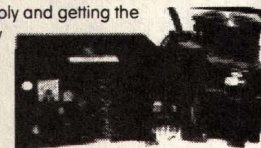
Single ear with over the head comfort. New, boxed with RJ11 style plug attached to 6ft. cable with clothing clip. Grey. **SPECIAL.... 19.95 or 2/\$35**



FREE ARGON LASER? 16mW Brilliant Tourquoise Blue, SPECTRA PHYSICS, 161B with POWER SUPPLY

Our low price is like paying for the power supply and getting the laser FREE! The 488nm, TEMoo mode is nearly 10X brighter than a 16mW HeNe! This is the laser you always wanted but couldn't afford. Perfect for that kick butt light show! All are in good, plug and play condition. Standard 115VAC operation. Integral fan cooling. We priced the whole system for less than others charge for the power supply alone. Why spend more? Always in demand. Limited Quantity.

New Price...\$5K+ SALE THIS MONTH ONLY....\$799



RESOURCES UNLTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL unlt4u@tiac.net

CIRCLE 283 ON FREE INFORMATION CARD

PRICES you can AFFORD

PANASONIC WV-D5000

DIGITAL, PROFESSIONAL, COLOR CCD CAMERA

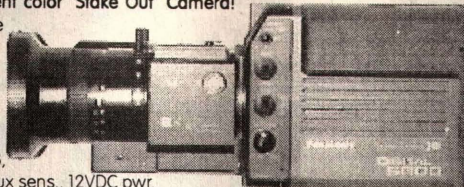
- 2/3" CCD • Auto/Man White Bal. • 8X f1.4 Zoom Lens • Auto/Manual Iris
- Auto Focus • 10.5 to 84mm W/ Macro • Manual Zoom • 3 Step AGC
- Stereo Mic Inputs • Earphone Output • Standard Composite (NTSC) Output
- Makes an excellent color "Stake Out" Camera!

These cameras were designed for news gathering and were used in high end tele-conferencing.

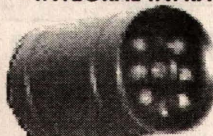
They are in excellent condition. S/N: 46dB.

Auto white bal., <7 lux sens., 12VDC pwr.

Size including lens is 10.75L x 4.5"W x 4.5"H., 380 lines res. Fixed shutter @1/1000 sec. for clear video of fast moving imagery. Manual, New CA-10 cable & New, Panasonic pwr supply. An impressive system. **Limited Qty, D5000....\$399**



SUPER! UNDERWATER (to 60 ft.) "LIPSTICK" CAMERA with INTEGRAL INFRA-RED ILLUMINATOR!



Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 3.6mm, 92° FOV glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" d. X

2" long. With 60 ft. cable. Great for gen'l outdoor use also. **GM-300K...\$199**

TWO MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412, The GM-412 specs:

B&W, size 1.5" sq. X 2.4"L, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX., Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting.

- True performance not hype! These cameras will outperform ANY camera in this magazine. Multi-lens options are available.

GM412, less lens..\$119, GM410, less lens..\$169

C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE: Fast Lenses for Low Light or General Purpose Normal Light

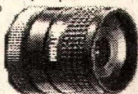
16mm, f1.6, 15° FOV	\$39	4mm, 80° FOV	\$24
8mm, f1.3, 40° FOV	\$49	8mm, 40° FOV	\$24
4mm, f1.4, 78° FOV	\$49	12mm, 28° FOV	\$24

Brand New, Video Motion Sensor. Model

VM-10. Attach to any std. video signal and you've got an electronic "watchman" diligently watching the entire scene. Or an adjustable sized area within the scene, such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac pwr. Adjustable sensitivity. Video loop through. **VM-10....\$189**

END FIELD of VIEW GUESSWORK, 3.5 - 8mm VARI - FOCAL LENS. New, super f1.8

lens allows adjustment from a 97° FOV @ 3.5mm to a 44° FOV @ 8mm. Frame your area of interest just the way you want it! Or use it to select a fixed lens of the desired field of view. Either way a handy item to have. Standard C-Mount with adjustable focus and iris. **\$99ea. 2 for \$189**



CHECK THIS! ULTRA MINI and WEATHERPROOF!



Our "LIPSTICK" camera sets new standards.

Sleek black anodized, aluminum, housing is O-Ring sealed & RAINPROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 12VDC @100mA, 3.7mm, 90° FOV lens. A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads. **GM-200KSTD...\$99, AC pwr...\$4.95**

PINHOLE LENS, "BULLET CAM"

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. **GM-200KPH...\$99**

NEW MICRO CAMERA, w/audio 1/3" CCD, 410

Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25" sq. x 1" d. PH is 0.6" d. Both with 6" leads.

WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD.....\$79	GM-1000A-STD/Audio.....\$84
GM-1000A-PINHOLE.....\$79	GM-1000A-PH/Audio.....\$84
GM-1000A-C-MOUNT...\$79	GM-1000A-CMNT/Audio..\$84

Micro Lenses for GM1000 series

2.5mm, 150°.....\$22	8.0mm, f2.0.....\$22
4.3mm, 78° f1.8.....\$22	12.0mm, f2.0.....\$22
6.0mm, f2.0.....\$22	5mm, 70°PH.....\$22

WORLDS SMALLEST, 100mW, VIDEO TRANSMITTER,

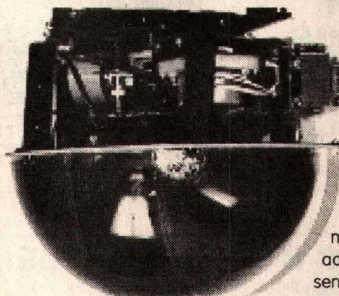
Only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled, hi-res., color or B&W images with 100mW output! The transmitter you've been waiting for. **Shown actual size.** Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned. Receive on cable channel 59. UHF Bow tie antenna with balun and 3' F cable for TV supplied. Perfect with GM1000A camera. Both will fit in a cigarette pack...with the battery! The best anywhere.

TVX-100.....\$189 with GM1000A-PH CAM.....\$268



\$5000 HI-TECH SURVEILLANCE SYSTEM

- **MOTORIZED, 6X ZOOM LENS**
- **MOTORIZED, 360° CONTINUOUS PAN**
- **MOTORIZED, TILT up to 90°**
- **PHILIPS HIGH RES. 1/2" CCD CAMERA**
- **OPAQUE BLACK INNER DOME**
- **CLEAR ACRYLIC OUTER DOME**



Walk into any major department store and you will see these fully integrated, surveillance systems. Made by the same manufacturer who supplied the Atlanta Olympics! These late model, new in the box systems are virtually ready to use. All you add is power. Philips B&W CCD camera, 450 lines res., 0.5 Lux sensitivity! Their best grade CCD. Commercial quality, anodized aluminum construction. Camera plus Pan & Tilt are powered by

external 24VAC via the included Pan & Tilt controller. Motorized, Zoom, Focus and auto-iris Controller also included. Size of dome: 14" diam. Ssystem includes drop ceiling mount.

COMPLETE SYSTEM with P/T and Zoom/Focus/Iris Controllers....\$895ea. 2 for \$1699

Please fax us your list of unique surplus material.



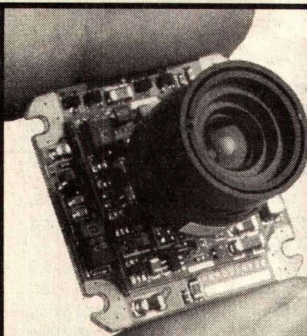
RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL unit4u@tiac.net

CIRCLE 293 ON FREE INFORMATION CARD

Micro Video Camera Sale



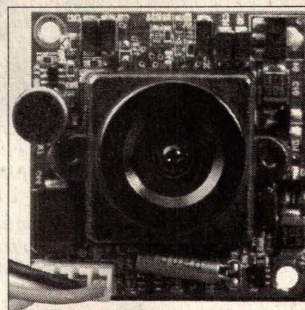
MB-45cB
Color Video Camera
2.8mm Lens
45° Angle of View
\$99.95

Size: 1.25" sq.



MB-650Ua
Black & White Video
Camera with Built-In
Audio & 4.3 mm Lens.
\$89.95

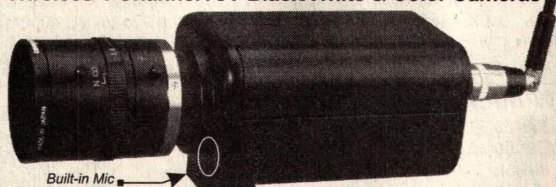
Size: 1.18" sq.



Wireless Cameras

Wireless Camera Package Deals, include: one camera, one receiver and power supplies. (Receiver holds up to 4 cameras)

Wireless 4-Channel A/V Black/White & Color Cameras



Built-in Mic
(on All models)
Cameras are shipped with 4.3mm lens.
(Camera shown with optional lens.)

GFS-1001 (900MHz)
GFS-2002 (1.2Ghz)

Wireless Transmitter & Receiver

2.4 GHz
Video/Stereo Audio

ONLY \$219.95



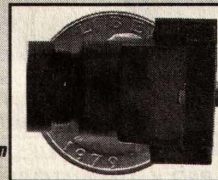
Dimensions: 2.5"(W) x 2.18"(H) x 3.28"(D)

Worlds Smallest Video Camera

No Bigger than the
size of a Quarter!
with CMOS Technology.

CM-550U - \$69.95
Pinhole Camera Available:
CM-550P - \$69.95

240 Line Horizontal Resolution
Size: 1.12"(L) .5"(W)



Micro Audio Receiver



• Audio Jack - RCA Female
• Power Jack - 2.1 Female Barrel Jack

MIC-300 - \$39.95

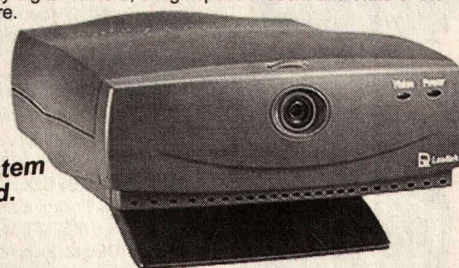
Video Conferencing

TeleEye has everything you need to do Color Video Conferencing. It comes with a built-in high quality digital camera, a high speed modem and state-of-the-art Audio/Video hardware.

Remote View Window
Up to 15 frames per second or VHS-quality resolution.

On-Screen Menus
Easy Control using your phone keypad.

\$499.⁹⁵
Stand Alone System
No PC Needed.



FREE
Polaris Product Catalogs



LP-850p
\$139.95

Length: 1.37"
Diameter: .87"

LP-850i
\$129.95

Length: 1.9"
Diameter: .91"

Outdoor
Model
Available
\$169.95



Polaris Industries

<http://www.polarisusa.com>

800.752.3571

Polaris Industries 470 Armour Dr. Atlanta GA 30324 Tech Info: 404.872.0722 FAX: 404.872.1038



SCO-1 - \$399.95
Observation System

Interfaces with existing Camera Systems!

System includes:

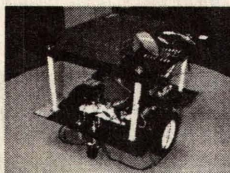
- Monitor
- Camera/100 ft. Cable
- Camera Stand/Mount
- 2-way Intercom Station
- 100 ft. Intercom Cable
- VCR Interconnect Cable
- One Year Warranty

SCO-1 - \$399.95
Observation System

CIRCLE 222 ON FREE INFORMATION CARD

Zagros Robotics

World Class Engineering and Programming



PO Box 460342
St. Louis, MO 63146-7342
(314)768-1328

info@zagrosrobotics.com
www.zagrosrobotics.com

PicC C Compiler \$59

for Microchip's PIC microcontrollers.

Supports PIC16C55x, 16C6x, 16C62x, 16C8x, 16C92x PIC families

SnXC C Compiler \$59

Supports ScenIX sx18ac and sx28ac microcontrollers

Both compilers based on ANSI C standard. Arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tools!

DebugIDE Debugger \$79

C source level debugger for PicC and SnXC compilers. Integrated Development Environment. Step, Run, Stop, Reset. Variable monitoring and modification. Oscillator/cable kit (\$39)

732-873-1519 fax: 732-873-1582 e: grichre@aol.com
Grich RC Inc. 120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873
URL: <http://members.aol.com/piccompile>

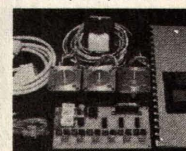
3 Axis Motion Control System Complete, ready to run

\$255.50 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc. Includes: 3 Stepping motors (70 oz/in 200 steps/rev). External board (connects to parallel port of a PC). Power supply. Cables, Manual and the MAXNC drive software, with linear, circular and helical interpolation, acceleration deceleration, full contouring, 'G' code programming, screen plot, code generation from CAD (CAM), and more.

For more information,
phone or write to:
MAXNC

6730 West Chicago
Suites 2 & 3
Chandler, AZ 85226
Ph (602) 940-9414
Fax (602) 940-2384



"I earned \$1,000 on just 12 VCR repairs in one week"

A true statement by Paul B.* of San Pedro, California

How to cash in on skyrocketing field of VCR repair!

You too can earn up to \$85 an hour, pocket \$200 a day, double your income...in the high-profit field of VCR repair...part-time or full time. There are over 77 million VCR's currently in use in America today - a lot of business out there just waiting for you!

Here is a once-in-a-lifetime opportunity to go into a booming business of your own, make really big money starting right away, be your own boss and enjoy financial freedom and security.

It's easy to learn VCR cleaning, maintenance and repair at home in just a few short weeks through Foley-Belsaw's unique method which emphasizes the mechanics involved in 90% of all repairs, without dwelling on all the unnecessary basic electronics. This exclusive practical hands-on course was developed and proven over a long period of time in an actual VCR repair shop. It combines simple step-by-step lessons with easy-to-follow video cassette guidance. No special experience or electronics background is necessary. Just average mechanical aptitude and the ability to follow simple A-B-C repair procedures that are clearly outlined for you. And when you complete the course you will receive the School's official diploma attesting to your expertise.

Send coupon today for FREE Fact Kit. No obligation.

Don't miss out on this opportunity to give your income a tremendous boost. Send in the coupon NOW. Get all the facts and study them in the privacy of your own home. There's absolutely no obligation and no salesmen will call on you. So don't delay. Mail the coupon today!

"I started 3 months ago, now earn over \$900 a week."
D.K., New York, NY

"Took in over \$3,200 in the past 10 days!"
H.H., Denver, CO

"Doubled my income within 6 weeks."
R.B., Bakersfield, CA

*Last name withheld by request.



MAIL TODAY FOR FREE INFORMATION PACKAGE

**Foley-Belsaw Institute,
6301 Equitable Road
Kansas City, MO 64120-1395**



CHECK ONE BOX ONLY FOR FREE INFORMATION KIT!

☐ **YES**, without obligation send me information on how I can learn at home to become a VCR technician. 62881

☐ TV/Satellite Dish 31652

☐ Electrician 94561

☐ Computer Specialist 38420

☐ Computer Repair 64783

☐ Computer Programmer 35599

☐ Networking Specialist 39407

Name

Address

City State Zip

February 1989, Electronics Now

386 MINI-PC \$83

1K PRICE
EVAL \$295
8088 \$27



- includes:
- 5 Serial, 3 Parallel (32bit max)
 - Up to 8 meg ROM (27C080)
 - 32k RAM exp. to 64Mbyte
 - Battery backed RT Clock
 - LCD and Keyboard ports
 - IRQ x15, DMA x2, TIMER x4
 - On-board LED display
 - Industry Standard PC Bus

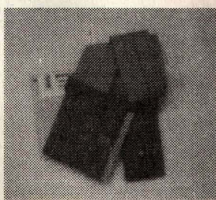
Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

A to D D to A CONVERTERS

For PC or SBC
8,12,16 bit resolution
up to 24 channels
starting at \$21 OEM (1k)
eval kit \$75

\$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM
up to 8 meg (27C64-080). Adapters for
micros, PLCC, etc. Parallel port version
for notebook. FAST AND EASY TO USE.



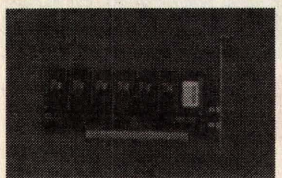
LOW COST... LOW POWER...

LOW RISC!

QTY 1K PRICE
\$1.99
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200	PINOUT:
OEM (1K) PRICE	\$2.57	\$1.99	
RS232 PROGRAM DOWNLOAD	NO	YES	RESET 1 20 VCC
SINGLE CHIP OPERATION	NO	YES	PD0 2 19 PB7
BUILT-IN BASIC	NO	YES	PD1 3 18 PB6
EEPROM DATA MEMORY	NONE	64	XOUT 4 17 PB5
PROGRAM MEMORY	768 OTP	1K FLASH	XIN 5 16 PB4
MATH REGISTERS	1	32	PD2/INT 6 15 PB3
MAX INSTRUCTIONS / SEC	5M	20M	PD3 7 14 PB2
MAX COUNTER BITS	16	18	PD4/TMR 8 13 PB1/AD1
INPUT / OUTPUT BITS	12	15	PD5 9 12 PB0/AD0
A TO D COMPARATOR	NO	YES	GND 10 11 PD6
HARDWARE INTERRUPTS	NONE	3	
- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -			

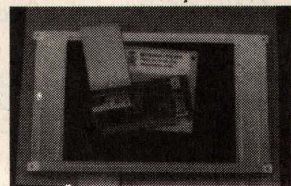


PC SOLID STATE DISK
\$21 OEM (1k) eval kit 75.00
FLASH / RAM / EPROM
256K-16M PCMCIA/DIPS

No More Hangups...
PC WATCHDOG!
Reboots PC OEM \$21 EVAL \$75



VGA LCD 640x480 controller
for PC or SBC
\$27 oem \$95 eval
combo LCD/CRT
version available



visit our web site: www.mvsweb.com

MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507

MVS

5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

DATA ACQUISITION & CONTROL

AFFORDABLE PLUG-IN BOARDS FOR PC's ISA BUS

ANA100 Analog I/O \$ 99



- * 8 Channel 8-Bit
- * 0 to 5 Volt Input
- * 14 TTL I/O lines
- * Analog Output
- * 400KHz Sampling

DIG100 Digital I/O \$ 39



- * 82C55 PPI
- * 24 or 48 TTL I/O Lines option
- * Selectable Base Address

ANA150 Analog/Counter... \$ 89



- * 8 Channel 8-Bit
- * 0 to 5 Volt Input
- * 3 16-Bit Counters
- * 400KHz Sampling

DIG200 Counter I/O \$ 79



- * 3 16-Bit Counters
- * 8 TTL Input lines
- * 8 TTL Output lines
- * Selectable Clock Frequency input

ANA200 Analog I/O \$ 79



- * 1 Channel 12-Bit
- * 0 to 5 Volt Input
- * optional bi-polar
- * 100KHz / 300KHz Sampling rate
- * 24 TTL I/O lines

ANA201 Analog \$ 119



- * 8 Channel 12-Bit
- * x1, x5, x10, x50 Programmable Channel gain
- * 100KHz Sampling rate

On-Line Product Catalog at Our Web Site

<http://www.Bsof.com>

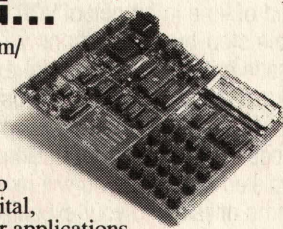
E-Mail: Sales@Bsof.com

BSOFT Software, Inc.

444 COLTON ROAD * COLUMBUS, OH 43207
PHONE 614-491-0832 * FAX 614-497-9971

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/
embedded control system.
Extensive manuals guide you
through your development
project. All programming and
hardware details explained.
Complete schematics. Learn to
program the LCD, keypad digital,
analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.
Money Back Guarantee

Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-550-8094, FAX 714-550-9941

AES
Advanced Educational Systems

Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

WinDraft® Schematics

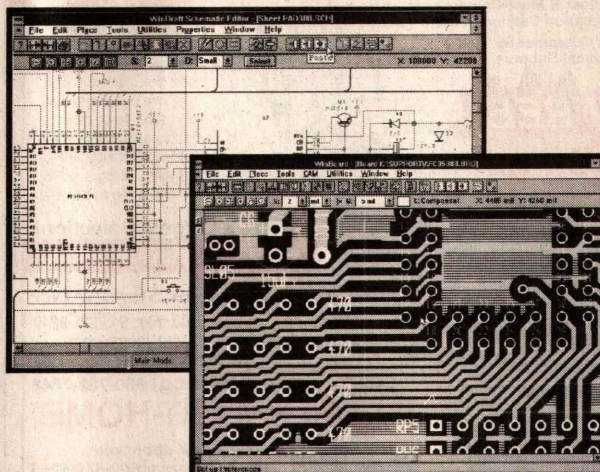
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique **pin capacity** versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

WinDraft 2.0 Available Now



\$ 250 WinDraft or WinBoard - P650
\$ 495 WinDraft or WinBoard - unlimited

\$ 895 WinBoard P650 with CCT
 Specctra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ivex. Your satisfaction is guaranteed!

World Wide Web: <http://www.ivex.com>

Information and free evaluation version is available on the Ivex WW Web, FTP and BBS.

Tel: (503) 531-3555
Fax: (503) 629-4907
BBS: (503) 645-0576



Ivex Design International. 15232 NW Greenbrier Parkway. Beaverton, Oregon 97006. USA.

ADV2_1

CIRCLE 319 ON FREE INFORMATION CARD

Look What As Little As \$25 A Month Can Get You These Days.

Help with college degrees. Fast cars. A first home. With as little as \$25 a month, a gift of U.S. Savings Bonds can help your kids with all kinds of future needs.

For more information, call toll free:
 1-800-4US BOND.



www.savingsbonds.gov

Filter Wiz v2.0

ACTIVE FILTER design software for Windows. Provides mastery of lowpass, highpass, bandpass and bandstop filters. Enhance critical signal components while controlling noise and other interference. Meets the needs of both novice and professional designer. Standard (LE) version \$89, PRO version \$199.

Download: <http://www.schematica.com>
sales@schematica.com FAX: 250-642-2644

February 1999, Electronics Now

The World's Largest Source for Home Automation

- The Best & Most Comprehensive Home Automation Catalog in the Industry
- Best Customer Service & Technical Support

FREE

160 page full color catalog!



Thousands of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software development tools, lighting control, telephone systems, security systems, surveillance cameras, infrared audio/video control, home theater, touchscreen control, HVAC, pet care automation, wiring supplies, books and videos and much more!

World's Largest Selection!

Lowest Prices Guaranteed!

HOME AUTOMATION SYSTEMS, INC.

Questions: 949-221-9200 Fax: 949-221-9240

e-mail: catalog@smarthome.com

www.smarthome.com

Call for a **FREE** Catalog! 800-762-7846

800-SMART-HOME

Dealers/Resellers ask about our
Smarthome PRO Dealer Program 800-949-6255

EPROM+ *The Professionals Choice!*

A rugged device programming system for bench and field

Uses parallel printer port!

Supports all standard parts!

Excellent, easy-to-use software!



IMPROVED!
New features,
more devices

FIRST GENERATION EPROMS 2708, TMS2716*, 25XX

SECOND GENERATION EPROMS (24, 28, 32 PIN) 2716 - 27C080 (8 MEG)

16 BIT EPROMS* (40, 42 PIN) 27C1024 - 27C160 (16 MEG)

FLASH EPROMS (28, 32 PIN) 28F, 29C, 29EE, 29F FAMILIES PLUS BOOT BLOCK DEVICES

EEPROMS/NVRAMS (24, 28, 32 PIN) 28C04 - 28C010, X2210/12, ER5901, PLUS DALLAS 12XX

SERIAL EPROMS* (8, 14 PIN) 17XX, 24XX, 25XX, 35XXX, 59XX, 85XX, 93XX, 95XX+ER1400

BIPOLAR PROMS* (16 - 24 PIN) 74SXXX AND 82SXXX FAMILIES

MICROCONTROLLERS* (ALL FAMILIES) 874X, 875X, 87C5XX, 87C75X, 89C5X, 89C051

89SXXX, 90SXXX, 68705, 68711, PIC12CXXX - 16CXXX, 17C4X PLUS FLASH AND 14000

• **READ, PROGRAM, COPY, COMPARE, FILE LOAD/SAVE (PLUS MUCH MORE!)**

• **FULL SCREEN EDITOR W/25 CMDS + BYTE/WORD MODES**

• **RUNS UNDER DOS, WIN3.1/95/98 AT ALL CPU SPEEDS**

• **SUPPORTS INTEL HEX, S-RECORD AND BINARY FILES**

• **MADE IN USA • 30 DAY MONEY BACK GUARANTEE**

\$289

SYSTEM INCLUDES: PROGRAMMING UNIT, PRINTER \$5.00 SHIPPING + \$5.00 C.O.D.

PORT CABLE, POWER PACK, SOFTWARE & MANUAL VISA • MASTERCARD • AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150

(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

CAD FILES TO CASH PILES



IMAGINE THE POSSIBILITIES!

ROUTE, MILL, DRILL, CARVE,

ENGRAVE, PAINT, ETC.

IN WOOD, PLASTIC, VINYL,

PC BOARD, & LIGHT METALS.

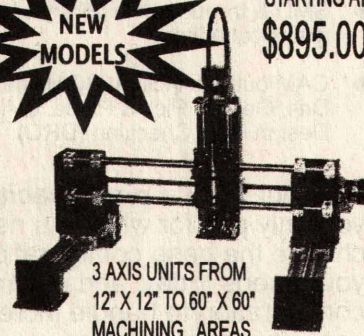
THE ROBOPRO X50

CNC ROBOTIC MACHINING SYSTEM

YOUR WISH IS ITS COMMAND!



**STARTING AT
\$895.00**



3 AXIS UNITS FROM
12" X 12" TO 60" X 60"
MACHINING AREAS

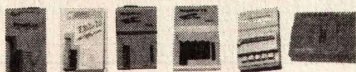
Visit us at
www.uscyberlab.com

U. S. CYBERLAB, INC., 14786 SLATE GAP RD., WEST FORK, AR 72774

VOICE (501) 839-8293 / 24 HR. FAX BACK (501) 839-8293

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAMS DATA I/O ICE TECHNOLOGY HILO
SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

CALL ADVANTECH LABTOOL	599 EETOOLS SIMMAX
629 ICE TECH MICROIV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUPA/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L	199 EPROM 16G TO 1 MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234

Web www.generaldevice.com E-Mail icdevice@best.com

Consumer
Information
Catalog

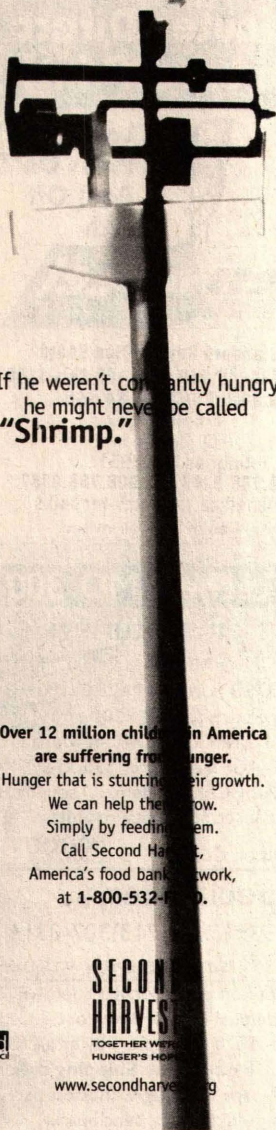
www.pueblo.gsa.gov

**9 out of 10
mice prefer it.**

Catch the free Consumer Information Catalog online and you'll get the latest info from the U.S. Government. Just point and click your way to **www.pueblo.gsa.gov** and you'll find more than 250 free publications ready to read or download.

Or, order the Catalog by mailing your name and address to **Free Catalog, Pueblo, CO 81009**. Scurry, this info's the cat's meow.

U.S. General Services
Administration



If he weren't constantly hungry
he might never be called
"Shrimp."

Over 12 million children in America
are suffering from hunger.
Hunger that is stunting their growth.
We can help them grow.
Simply by feeding them.
Call Second Harvest,
America's food bank network,
at 1-800-532-5209.

**SECOND
HARVEST**

TOGETHER WITH
HUNGER'S HUMANITY

www.secondharvest.org



Buy recycled.



It would mean
the world to them.

Recycling keeps working to protect
their future when you buy products
made from recycled materials. For
a free brochure, write *Buy Recycled*,
Environmental Defense Fund, 257
Park Avenue South, New York, NY
10010, or call 1-800-CALL-EDF.



Modern computing and standard surge suppressors...a recipe for disaster.

Almost all surge protection devices use MOV's (metal oxide varistors) as their active element. MOV's are sacrificial/wear/limited life components. Surge suppressors based on this technology are doomed to failure. These surge "suppressors" also don't suppress a thing. They divert powerline surges equally to the ground and neutral wire. When you put current on the common ground wire of interconnected equipment some of that current will flow (through the inherent ground loops) to the data lines. This is a major cause of lock-ups and misoperations that plague today's computer environments. Another fact; all modern computers use switch mode power supplies. During surges the power supply capacitors must charge to the clamping level of the MOV before the MOV turns on. A recent study has shown that it takes a 3000A surge 15 microseconds (15,000 nanoseconds) to charge the typical capacitors of these power supplies to that level. The surge is virtually over before the MOV reacts. (See *five things you probably don't know about your surge suppressor at www.fivethings.com.*)

THE POINT: Standard surge suppressors allow too much current to hit the computer. Standard surge suppressors divert surge current to the ground wire and disrupt data transfer. Standard surge suppressors eventually fail without warning. Modern computers have logic voltage levels (the signals that transmit the data) and power supply voltages that are dramatically lower than that of their recent predecessors. Modern computers use integrated circuits with transistors of ever decreasing physical geometries. Modern computers are virtually always interconnected to other computers or peripheral equipment. The bottom line; *modern computers are much more sensitive and susceptible to powerline anomalies.*

INTRODUCING BRICK WALL SURGE FILTERS. . . *The World's Best Surge Suppressor*

Initially engineered for critical, non-fail industrial applications, this patented device protects indefinitely and sets a new standard for every measure of surge suppressor and powerline filtering performance.

A Brick Wall 1) Utilizes NO MOV'S or Any Other Sacrificial Components (a two pound inductor and nine capacitors are the heart of the unit) 2) Has No Joule Rating or Surge Current Limitations 3) HAS BEEN TESTED AND CERTIFIED BY UL TO THE MOST DEMANDING CLASSIFICATION OF A NEW GOVERNMENT SPECIFICATION; CLASS I, GRADE A. Which Means: UL PUT ONE THOUSAND 3000A, 6000V SURGES (this is the largest surge an interior environment can experience) THROUGH A UNIT (at 60 second intervals) AND DOCUMENTED NO FAILURE OR PERFORMANCE DEGRADATION OF ANY KIND WHATSOEVER.

i.e.: A Brick Wall Will Not Fail.

We know of no cord connected, MOV based surge protection device that has, or can pass this test.

A Brick Wall possesses UL's lowest Suppressed Voltage Rating (let-through voltage) of 330V. This is the lowest rating they will grant. In that test of one thousand 6000V, 3000A surges, UL NEVER SAW THE LET-THROUGH VOLTAGE EXCEED 290V. YOU CANNOT DO BETTER THAN THIS FOR A POINT-OF-USE SURGE PROTECTION DEVICE. Once again, we know of no other surge protection device that could come close to this performance level.

A Brick Wall is a current activated Series Mode device. Since it is not wired in parallel, nor voltage activated, it does not have to wait for the capacitors of the power supply to charge before it becomes effective. YOUR EQUIPMENT IS PROTECTED INSTANTANEOUSLY (and indefinitely).

These devices were engineered utilizing a current limiting/surge filtering technology. THEY DO NOT DIVERT ANY SURGE CURRENT TO THE GROUND WIRE. They Will Not Cause Your Computer System To LOCK-UP, CRASH OR MISOPERATE as a consequence of surge diversion. Your current surge "suppressor" will.

Powerline Filtering

In addition to all this, Brick Wall Surge FILTERS are the best AC powerline filters you can buy (that we have been able to find anyway). Industrial machinery, copiers, coffee makers, laser printers, fluorescent lights, refrigerators, etc., all cause powerline noise that can cause your computer to misoperate. A Brick Wall Surge Filter will make powerline noise related problems disappear.

**You Can't Buy a Better Surge
Protection/Powerline Filtering
Device...Anywhere.**



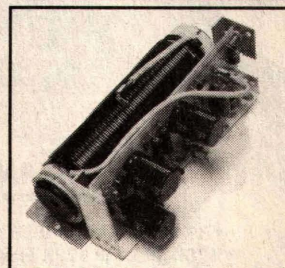
**BRICK WALL DIV.,
PRICE WHEELER CORP.
1-800-528-0313**

Fax: 1-800-528-6623 E-Mail: info@brickwall.com

Web: www.brickwall.com

Visa - MC - AMEX

ASK ABOUT OUR NEW IN-LINE UPS/SERVER PROTECTOR



Available in Modular Form

Direct from Manufacturer
We will beat any competitor's price

World's Smallest Wireless Video Camera!

- Transmits video up to 1000 ft.
- Runs on 1 qv. battery for 12 hrs.
- Can be built into just about anything (beeper, clock, etc.)

We also carry:
• Color micro video cameras
• B&W micro video cameras
• Hidden cameras
• Custom video systems
• Countersurveillance
• More

World's smallest
plug & play system
about 1" x 1"

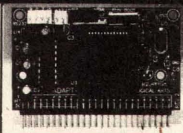


Looking
for
Distributors

Call for a free catalog (305) 667-4545
SECURETEK Fax (305) 667-1744
1715 SW 47 St. #205 • Miami, FL 33155

ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
 - plugs vertically into solderless breadboard for easy development
 - BOOT/RUN switch for easy programming via PC serial port
 - all I/O lines on dual row connector
- Complete modular prototyping system!
Expansion accessories available!



For just US\$74.95, our Starter Package (AD11SP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC11E2, providing 2K EPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of 'HC11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (or use our modular accessories).

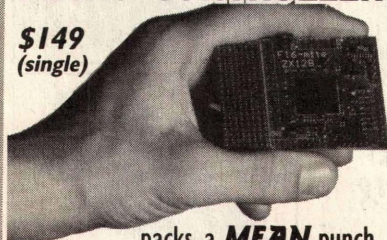
Visa • MasterCard • AmericanExpress • Discover

TECHNOLOGICAL ARTS

309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462
1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2
voice/fax: (416) 963-8996 www.interlog.com/~techart

FRIENDLY LITTLE MICRO CONTROLLER

\$149
(single)



...packs a **MEAN** punch
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •



Inter Automation Inc.
www.steroidmicros.com

v: 250-721-5150
fx: 250-721-4191

www.jm-micro.com

PIC In-Circuit Emulator
for the PIC16Cxx from \$295
PIC Programmer \$155

80C552 (8051) Development
Training System \$235
68HC11 SBC \$120

ROMY-16 EPROM Emulator
from \$195

Universal Microprocessor
Simulator/Debugger (including
Assembler, and Disassembler)
\$100 each CPU

J&M Microtek, Inc.

83 Seaman Rd, W Orange, NJ 07052
Tel: (973) 325-1892 Fax: (973) 736-4567

PIC Microcontroller Programmer Kit

Super Value! • Program all 8, 18, 28 & 40 pin PICs in the 12C5xx, 14000 and 16Cxx series (except 16C54-58). • All components, PCB and Instructions included. • Parallel port of PC is used with straight through (25 pin) cable (not supplied). • This kit uses the P16PRO shareware which is downloaded from the web and registered for \$25. • Visit www.electronics123.com for the complete list of PICs that can be programmed and for more information. • Can program 64 pin PICs with adapter (not supplied).

Running Lights Kit

Ideal for parties, discos, shop windows and X-mas decorations. 8 LEDs switch on and off in 10 push button selectable patterns. 8 different speed levels for a total of 80 combinations! Includes PCB, components & instructions. Uses a 51 microcontroller. Can operate light bulbs by using TRIACs. (8x TRIACs is \$6 extra) *S&H to Canada is \$7.95

Orders only: 1-888-549-3749 (USA & Canada)
Info: (330) 549-3726 Request a FREE catalog or visit us at: www.electronics123.com for more products.
Amazon Electronics, Box 21 Columbiana OH 44408

LASER MODULE



Auto Power Control
Collimated Laser
Compact Size
100,000 hr lifetime
No Electronics Required

Visible Laser Modules (635-670 nm)
TTL Modulated Laser Modules
Line Generator Laser Modules
Infrared Laser Modules (780-830 nm)

from
\$29 (US)

LASER POINTER



Focus Adjustable
Elegant Design
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)
Key Chain Laser Pointer (1500 ft visibility)
Available in silver and, black finish.

\$19.95 (US)

World Star Tech.

Ask for free catalog
Tel: (416) 204 6298 Fax: (416) 596 7619
<http://www.worldstartech.com> e-mail: info@worldstartech.com

Printed Circuits in Minutes Direct From LaserPrint!

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch



Use Standard Copper Clad Board
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100
Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.
P.O. Box 463

Ringoes NJ 08551

ph. 908.788.8249 fax 908.788.8837

<http://chelsea.ios.com/~techniks>

Retail Dealer Inquires Invited

1 MB cache, AMD 300

3DNow System featuring:
Enlight Mini Tower, VIA chipset, 100 MHz operation, 2 USB ports, 64 MB PC-100 compatible memory, 7.5 GB 7200 rpm Ultra DMA33 hard drive, 32X CD-Rom with audio button, 4 MB AGP video card, S3 Trio 3D, 1.44 floppy, V.90/X2 PCI faxmodem, 3D sound card full-size speaker set, 15" digital monitor.

Windows 98 on CD **\$997**

tech-specialities, Inc.

(800) 864-5391, fax: (713) 307-0314

email: sales@ts.nu, web: www.ts.nu

Detailed Quote on other configurations (PII 300/450, single/dual CPU or low cost, 233 MHz, 32 MB - \$570 w. monitor) by email, fax or phone. Ask for our Free Shipping option! Illustrated 32-page Catalog with latest parts, many more system options, benchmark comparisons and technical tips free!

10 Hr. Telephone Recorder \$69

+\$6.95 S/H



FCC Approved

6 Hr. Tape included!

Automatically starts recording when the phone is picked up and stops when you hang up. Records both sides of the conversation!

Telephone recording controller only \$15
3 Hour Micro Telephone recorder with tape \$49

FREE CATALOG
www.mscelectronics.com

MSC Electronics
PO BOX 461 Jessup, MD 20794

(301) 497-1600

FAX (301) 497-1925



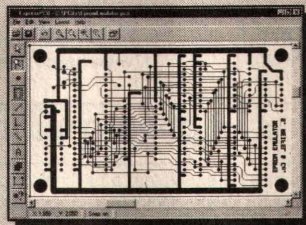
THE COLLECTED WORKS OF MOHAMMED ULLYES FIPS

#166—By Hugo Gernsback. Here is a collection of 21 April Fools Articles, reprinted from the pages of the magazines they appeared in, as a 74-page, 8½ × 11-inch book. The stories were written between 1933 and 1964. Some of the devices actually exist today. Others are just around the corner. All are fun and almost possible. Stories include the Cordless Radio Iron, The Visi-Talkie, Electronic Razor, 30-Day LP Record, Teleyeglasses and even Electronic Brain Servicing. Get your copy today. Ask for book #166 and include \$9.99 (includes shipping and handling) in the US (First Class), Canada and Overseas (surface mail), and order from **CLAGGK Inc., P.O. Box 4099, Farmingdale, NY 11735-0793**. Payment in US funds by US bank check or International Money Order. Allow 6-8 weeks for delivery. MA05



PC Boards Under \$100

- 1 Download our FREE layout software
- 2 Design your 2 sided plated-through PCB
- 3 Send us your layout over the Internet
- 4 In 2-3 business days, UPS delivers your boards, typically under \$100



www.expresspcb.com

CABLE TV DESCRAMBLERS

***GUARANTEED
LOWEST PRICES*
*DESCRAMBLERS
FOR ALL SYSTEMS***

FREE SHIPPING

**CRAZY LIZ'S ELECTRONIC
WAREHOUSE**

CALL TODAY!

1-800-391-7803

EQUIPMENT IS NEW & GUARANTEED

**Yours for only
\$3.99**

**Prices includes
shipping!**



**HAVE A THOUSAND YUCKS FOR ONLY
THREE AND A HALF BUCKS!** That comes to one-third of a cent per laugh. Electronics Comics is a compilation of over 125 riotous, outrageous and phenomenal cartoons that appeared in **Popular Electronics** and **Electronics Now**. Only \$3.99—price includes shipping. **Claggk, Inc., Reprint Bookstore, P.O. Box 4099, Farmingdale, NY 11735-0793**. All payments in U.S. funds. Sorry, no orders outside U.S.A. and Canada. Check or money order only—send no cash. NY state residents add applicable tax. MA04

**American Heart
Association**
Fighting Heart Disease
and Stroke



**Research
gave him
a future**

**Support
Research**

©1995, American Heart Association

GALEP-III Pocket Multiprogrammer

**This size
fits all!**



◆ Programs 8-bit and 16-bit EPROMs, EEPROMs, Zero Power RAMs, Flash, serial EEPROMs ◆ GAL, PALCE, ATF ◆ 87xxx, 89xxx, PIC12/16/17Cxx ◆ All DIL devices without adaptor ◆ **Lightning fast** parallel data transfer (e.g. 27C512 read/compare 2 sec!) ◆ Power supply independent due to **rechargeable battery** ◆ Uses PC printer port ◆ Hex, JEDEC, and binary file formats ◆ Hex and fusemap buffer editor ◆ Split & shuffle for 8-bit, 16-bit and 32-bit targets ◆ Runs under Win3.1, 95, 98 ◆ 'Remote control' by DDE scripts ◆ Designed for the future due to flexible pin driver technology - new devices will be added every month ◆ Device list, demo software and **lifetime free updates** from our website www.conittec.com

GALEP-III Set, with cable, battery, recharger \$389.00

PLCC Adapter for 8-bit EPROMs / 16-bit EPROMs / GALs each \$149.00

CONITEC 1951 4th Ave, Ste 301 • San Diego, CA 92101
Tel: (619) 702-4420 • <http://www.conittec.com>

SCIENCE FAIR ELECTRONICS

One of the largest electronic kit selection

Address: 9740 CAMPO RD. #209
SPRING VALLEY, CA 91977

PHONE: (619) 668-0078
TOLL FREE 1-800-475-0349
FAX: (619) 668-0054

We Carry Electronic Kits, Robots,
Motors, Tools, Test Equipment,
batteries, etc.

To receive a **FREE CATALOG** fax or
mail your address with phone number
to the address above and you will
automatically become a member with
no extra charge.

Notch Filters



Test Chips

Filter Kits
1 to 2 \$20 each
3 to 9 \$15 each
10 to 20 \$9 each
21 or more \$7 each

**Adult Wholesale
Video's**

**\$ 379.00
Free Shipping**

Video Media
P.O. Box 93/6025
Margate, FL 33093-6025
(954)-752-9202

www.nutnet.com



SURVEILLANCE HIDDEN CAMERAS DIRECT FROM MANUFACTURER—BEST PRICE IN THE MARKET

Ultra miniature hidden camera. In dome, smoke or motion detector w/ mic. S/W or Color. Wide view angle. Low light sensitivity + super sharp images, plus video and audio output. From \$159.00. Also 1/8" B/W board camera w/mic, starts at \$79.00 USD. Wireless hidden camera, start at only \$249.00 USD. Plus \$5.95 for S/H. Wholesale Welcome. C.O.D., Check, Money Order or Visa/MC.

BOLIDE INTERNATIONAL CORPORATION
PH: (800) 355-0895 or (626) 575-8178
9660 Flair Drive #218, El Monte, CA 91731
<http://www.bolideinternational.com>

Cable T.V. Converters & Equipment

**Lower
Prices
Dealer
Discounts
30-Day
Money back
1-year
warranty
MC, Visa,
AE, COD**



No Florida Sales

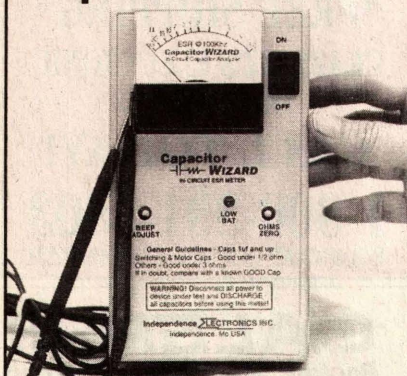
www.cable4you.com

1-(800) 888-5585

February 1999, Electronics Now

Find Bad Capacitors

In-Circuit with the Capacitor Wizard



The Capacitor Wizard is an extremely FAST and RELIABLE device designed to measure ESR (Equivalent Series Resistance) on capacitors of 1uf and larger "IN CIRCUIT", eliminating the need to remove the capacitor for accurate tests. The Capacitor Wizard finds BAD caps IN CIRCUIT that even VERY EXPENSIVE cap checkers MISS ENTIRELY, even out of the circuit!! Standard capacitor meters cannot detect any change in ESR therefore they miss bad capacitors leading to time consuming "Tough Dog" repairs. *Technicians say it is the most cost effective instrument on their workbench.*



Made in the USA

Order Today

Only \$179.95
Call 1-800-394-1984

<http://www.heinc.com>

Int. # 316-744-1993

Fax 316-744-1994

6222 N. Oliver, Kechi, KS 67067

30 day money back guarantee



CLASSIFIED

AUDIO-VIDEO-LASERS

Unique Video Products Pattern Generators with character identification, composite, s-video, RGB, distribution amplifiers, kits also available, FREE catalog, **GEKCO Labs**, PO Box 642 Issaquah, WA 98027-0642, 888-435-7221, www.gekco.com.

BUSINESS OPPORTUNITIES

Have an idea? If so, we are a national company working with ideas, inventions, new products. Patent services. Call 1-800-288-IDEA.

\$400 WEEKLY ASSEMBLING Electronic circuit boards/products from home. For free information send SASE: Home Assembly-EN Box 216 New Britain, CT 06050-0216.

Microwave oven repair course. Universal training manual, schematics, free microwave power detector, technician's certificate. \$60.00, **MOTS TECH**, Box 29141, Thunder Bay, Ontario, Canada. P7B6P9.

Wholesaler looking for retailer to carry solar electronic and hobby goods. (916) 486-4373. Please leave message.

CABLE TV

CABLE test modules/cubes. Pioneers, S/A, Tocom, Jerrolds. Quantity discounts, Call **DCR**: Tel: (718) 624-8334, Fax: (718) 246-9731, No NY calls.

Descramblers, Converters, Activators, Rft's, Ftg's, Bullet Snoopers. All options explained, best prices, services, 2yr warranty, free catalog 1-800-854-1674, www.resourceleader.com/aapc.

Pay TV & Satellite Descrambling 1999 Edition. All the latest cable and satellite fixes \$16.95. Complete Pay TV series (282 pages) \$59.95. Hacking Satellite Systems video \$29.95. Scrambling News subscription with web access \$34.95. Everything listed above \$99.95. Free catalog. **Scrambling News**, 4798 South Florida Ave., Lakeland, FL, 33813. 941-646-2564. COD's are OK. Add \$6.

CABLE TV Descramblers. One piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Precision Electronics** Houston, TX. Anytime. 1-888-691-4610.

Free Cable Descrambler Plans. For Details Write: **Sierra Publishing**, 909 E. Yorba Linda Blvd., Suite H-181, Dept ENX, Placentia, CA 92870.

CUBE for Jerrold Model CFT-2200, 2014, 2024, 2254, Pioneer 6300-6310, Auto-Multimode, Zenith ST-1600 \$175.00. Lowest price call 800-822-8530.

CABLE TV EQUIPMENT & ACCESSORIES. Wholesalers Welcome! 30 Day Moneyback Guarantee! Free Catalog! **PROFORMANCE ELECTRONICS, INC.** 1-800-815-1512.

CABLE DESCRAMBLING, New secret manual. Build your own Descramblers for Cable and Subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

Wholesale to the public. The industries leading distributor of cable electronics is now open to the public. We will beat all competitors pricing. **Dimension** 1-800-474-2343.

NEW! Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, converter boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$59.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

Cable TV descramblers. All major brands. Have make and model number of converter used in your area when calling. Quantity discounts. **K.D. VIDEO**, 1-800-327-3407.

Cable boxes all models, all channels, lowest prices in the United States. Open seven days a week till midnite, Pacific time. Call (877) 789-7337 toll-free.

Free Cable TV t-shirt with the purchase of a radio frequency test cube, converter or video stabilizer. We will beat any price!!! **Cable USA, Inc.** 1-888-388-CUBE.

NEW! Jerrold and Pioneer wireless test units \$125 each, also 75DB notch filters \$19.95 each, quantity pricing available, please call **KEN ERNY ELECTRONICS**, 24 hour order and information hotline 516-389-3536.

All cable TV boxes. We'll beat any price. 30 day trial, 1 year warranty. 1-800-538-CABLE(2225).

CB-SCANNERS

CB Radio Modifications! Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best since 1976! Catalog \$3.00. **CBCL**, Box 1898EN, Monterey, CA 93942. www.cbclntl.com

CB Trick Books, three books 1, 2 and 3. Each book \$19.95 each. Repairs, tune-ups, and amplifiers. Send money order to **Medicine Man CB**, P.O. Box 37, Clarksville, AR 72830.

COMPUTER HARDWARE

New computers and parts at wholesale prices. www.techass.com Toll free 1-877-Tec-hass. We ship all parts and computers. 1-877-832-4277.

EDUCATION

Learn electronics. Home study. Outstanding careers. Free literature. **P.C.D.I.**, Atlanta, Georgia. Call 800-362-7070. Dept. ELB342.

BE A COMPUTER SUPPORT SPECIALIST! Learn computer hardware and software. Great career path. Computers are the future. Free information. Call 1-800-326-9221 or write **Lifetime Career Schools**, Dept: ELN1029, 101 Harrison Street, Archbald, PA 18403.

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

BAD CREDIT? Learn to increase, improve and repair bad credit. \$20 + \$4.00 (S&H). James Brown, 1201 Bethlehem Pike, Suite 105-(ELE), North Wales, PA 19454.

SHOP A NEW ERA DISCOUNT CYBERMART. LOGON
www.aukey.com

PLANS-KITS-SCHEMATICS

AWESOME KITS: Voice Changers, Levitators, Lasers, Solar Robots and more! Catalog \$1.00.
LNS Technologies, PO Box 67243, Scotts Valley, CA 95067 www.ccnet.com/~lnstech.

CATALOG: Broadcasting/micro transmitters, amplifiers, antennas. **Start your own radio station books.** Audio, TV, Ham, CB, Surveillance, Science projects and more. www.panaxis.com **PAN-COM Int'l**, PO Box 130-2, Paradise, CA 95967.

ELECTRONIC PROJECT KITS: 49 McMichael St, Kingston, ON., K7M 1M8. \$3.00 catalog. www.qkits.com. **QUALITY KITS.**

REPAIRS-SERVICES

SAVE TIME! Do you repair TV's and monitors? With **Quick Fix**, no repair should take more than 1/2 hour guaranteed. Just follow the step-by-step **universal** repair chart. Sold on tapes @ \$299.95. Now only \$49.95 (and 30 minutes tech assistance). For more information send SASE to **Quick Fix**, 1794 Erringer Rd., Simi Valley, CA 93065 or call (805) 522-2193.

SATELLITE EQUIPMENT

FREE CATALOG - Satellite TV/GPS-DIY. Technical Books, Installation Videos, Computer Analysis Software www.baylin.com 800-843-2425.

SKYVISION! Your Satellite Home Entertainment Source. **Best values:** DBS and C/Ku-band equipment, including 4DTV. Most complete selection: Parts-Tools-Upgrades-Accessories! **Free** Discount Buyer's Guide. Call 800-543-3025. International 218-739-5231. www.skyvision.com.

DSS Hacking: How to construct and program smart cards, with pic16C84, PCB layout. Complete DSS system schematics, \$16.95. Software \$25.
CABLETRONICS Box 30502R, Bethesda, MD 20824

TEST EQUIPMENT

TEST EQUIPMENT SALE! Complete listing at <http://www.astglobal.com> or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS:** Voice: 888-216-7159, Fax: 814-398-1176, e-mail: sales@astglobal.com

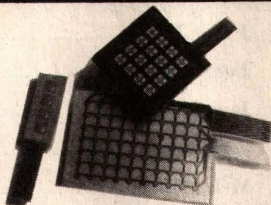
WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. AST GLOBAL ELECTRONICS: Voice: 888-216-7159, Fax: 814-398-1176, e-mail: sales@astglobal.com

WANTED: HEATHKIT ID-4001, ID-1890, ID-1990, ID-2090 (working) Digital Weather Computers. Also, microprocessors for above. heathkit@usa.net

ELECTRONIC SHOPPER

MEMBRANE SWITCHES



Stock Layouts!

Eliminates tooling cost...

****From 2 to 128 keys****

Industrial/Commercial/Prototyping

Popular types are available as complete kits, with bezel, connector & overlay!

4 key DSK-4 kit \$9.60

12 key DSK-12 kit \$13.87
many more layouts...

Optional Stainless Steel "Clickdomes".

Sil-Walker

(805) 491-0654

FAX (805) 491-2212

P.O. Box 3220

Camarillo, CA 93011-3220

silwkr@vcnet.com

www.vcnet.com/silwkr/

MASTERCARD/VISA

Timid about getting on the... World Wide Web?

You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, **The Internet and World Wide Web Explained**, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #BP403 send \$7.99 plus \$3.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

CABLE TV EQUIPMENT

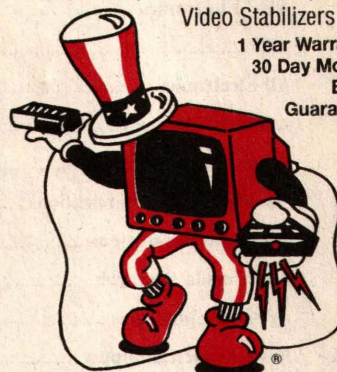
Converters, Test Cubes & Chips
Video Stabilizers

1 Year Warranty

30 Day Money

Back

Guarantee



"ABSOLUTE LOWEST WHOLESALE & RETAIL PRICES"
CABLE U.S.A.
1-888-388-CUBE

POPTRONIX®

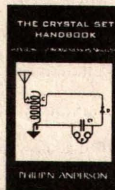
Online Edition

We're on the web FREE

<http://www.poptronix.com>

**WE'RE WITH YOU EVERY DAY
24 HOURS A DAY! DROP IN!
WE'D LOVE TO HAVE YOU VISIT!**

Get your copy of the CRYSTAL SET HANDBOOK



Go back to antiquity and build the radios that your grandfather built. Build the "Quaker Oats" type rig, wind coils that work and make it look like the 1920's! Only **\$10.95** plus \$4.00 for shipping and handling. **Claggg Inc., P.O. Box 4099, Farmingdale, NY 11735. USA Funds ONLY!** USA and Canada—no foreign orders. Allow 6-8 weeks for delivery. **MA01**

HI-TECH SURVEILLANCE

Pinhole Cameras, Recording Devices, Bug Detectors, Lasers, Lockpicks, Pen Knives, Tracking Devices, Wireless Mics, Books/Videos, plus much more!!!!

FOR CATALOG - SEND \$5.00 TO:

Spy Way

P.O. Box 61805, Jax, FL 32236

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number ...Page	
— Abacom Technology	68	— J&M Microtek, Inc.....90	
— ABC Electronics	79	— J-Tron Inc.....79	
— AES	86	— Jameco.....CV3	
214 All Electronics.....	73	— James Electronics	79
— Allison Technology.....	75	— Lynxmotion	78
— Amazon Electronics.....	90	— M ² L Electronics.....	78
270 American Eagle Publications	75	325 Mark V Electronics	80
218 American Innovations.....	76	327 MCM Electronics	65
— Andromeda Research.....	88	334 Merrimack Valley Systems	86
— Arrow Technologies.....	60	133 MicroCode Engineering	CV2
313 Basic Electrical Supply	70	— Micro Test.....	76
— Brand Electronics	71	— microEngineering Labs.....	76
— Bsoft Software Inc.	86	— Modern Electronics	78
309 Butterworth Heinemann.....	64	318 Mouser Electronics.....	60
322 C&S Sales, Inc.	66	— MSC Electronics.....	90
— Cable USA.....	93	— NRI Schools.....	37
— Circuit Specialists.....	74	219 Netcom.....	71
— CLAGGK, Inc.....	11	262 Parts Express Inc.....	63
— Clearview Group	78	— Pioneer Hill Software	74
— Cleveland Inst. of Electronics.....	29,51	222 Polaris Industries.....	84
— Command Productions	68	315 Prairie Digital	71
— Conitec.....	91	— Price Wheeler.....	89
226 Consumertronics.....	60	264 Print (Pace)	77
— Crazy Liz's.....	91	266 Ramsey Electronics	81
— EDE - Spy Outlet.....	78	283 Resources Unlimited.....	82
323 Electronix Express.....	62	— Science Fair Electronics.....	91
— Emac Inc.....	75	— Securetek	90
— Engineering Express.....	91	— Sil Walker	93
335 Foley-Belsaw	85	— Square 1 Electronics.....	68
— General Device Instruments.....	88	— Tech-Specialties.....	90
131 Global Specialties	7	— Techniks.....	90
— Grantham Col. of Engineering	4	— Technological Arts	90
— Home Automation	88	311 Telulex.....	70
— Howard Electronics.....	92	333 Test Equipment Depot.....	72
331 Howard Electronics.....	61	217 Test Equipment Sales	80
— ICS Computer Training.....	9	275 Timeline	62
— IEC.....	74	— U.S. Cyberlab.....	88
— Information Unlimited.....	72	282 Velleman	69
— Intec Automation	90	— Video Media	91
138 Interactive Image Technologies.....	CV4	— World Star Technologies.....	90
319 IVEX Design	87		

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931
1-(516) 293-3000
Fax 1-(516) 293-3115

Larry Steckler
publisher (ext. 201)
e-mail advertising@gernsback.com

Adria Coren
vice-president (ext. 208)

Ken Coren
vice-president (ext. 267)

Christina Estrada
assistant to the publisher (ext. 209)

Marie Falcon
advertising director (ext. 206)

Adria Coren
credit manager (ext. 208)

For Advertising ONLY EAST/SOUTHEAST

Megan Mitchell
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Phone 702-240-0184
Fax 702-838-6924
mmitchell@gernsback.com

MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen
Midwest Advertising
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-847-559-0555
Fax 1-847-559-0562
bergenrj@aol.com

PACIFIC COAST

Anita Bartman
Pacific Advertising
Hutch Looney & Associates, Inc.
6310 San Vicente Blvd., Suite 360
Los Angeles, CA 90048-5426
1-323-931-3444 (ext. 227)
Fax 1-323-931-7309
anita@hlooney.com

Electronic Shopper

Joe Shere
National Representative
P.O. Box 169
Idyllwild, CA 92549-0169
1-909-659-9743
Fax 1-909-659-2469
Joe@greencafe.com

Megan Mitchell
National Representative
9072 Lawton Pine Avenue
Las Vegas, NV 89129-7044
Phone 702-240-0184
Fax 702-838-6924
mmitchell@gernsback.com

Customer Service

1-800-999-7139
7:00 AM - 6:00 PM M-F MST

Circuit Board Software

CircuitMaker® Simulation Software

CircuitMaker gives you professional schematic design and fast, accurate SPICE-based simulation in one complete program!

- Library of 4000+ devices models
- 6 analyses and 8 virtual instruments

Part No.	Description	Price
125591	Simulation Software	\$279.95

TraxMaker PCB Layout Software

Compatible with
CircuitMaker®

TraxMaker is a professional PCB layout program with built-in autorouter.

- Multi-pass, gridded autorouter
- Supports up to 8 layers
- Fully documented library of 2,000 footprints

Part No.	Description	Price
139301	PCB Layout Software	\$279.95

WinDRAFT Schematics/ WinBoard PCB Layout Software

"...still one of the most flexible, best featured, and economical schematic capture programs on the market suitable for professional use." —Desktop Engineering

- Minimum system requirements: 486/ DX2, 10MB hard drive space, 8MB RAM, SVGA (800 x 600)
- Support up to 450 pin designs

Part No.	Description	Price
142981	Electronic Schematic CAD	\$149.95
142973	Electronic PCB CAD	\$149.95

EDWin NC Electronics CAD/CAE Software

The first truly seamlessly integrated suite of software running in all Windows® formats... simulation, schematics, and PCB design.

Part No.	Description	Price
141680	EDWin NC Software	\$139.95
147627	Deluxe 4 Software	\$259.95

GLOBAL SPECIALTIES®

Protolab 4.0 Software

- A low-cost circuit design and simulation software.
- Includes 3.5" diskette and basic instructions
- System requirements: IBM PC 386; 4MB RAM; SVGA graphics; Windows® 3.1 or 95

Part No.	Description	Price
150682	Protolab 4.0 Software	\$49.95

Robotics

OWI Robotic Arm Trainer Kit

Five Axis of Motion

Teaches the basic robotic sensing and locomotion principles while testing your motor skills as you build and control the arm. This unit can be commanded or instructed through its five switch wired controller with lights to grab, release, lift, lower, rotate wrist, and pivot sideways.

- 109 pc. kit - Advanced level

Part No.	Description	Price
157366	Robotic Arm Kit	\$69.95

Sprockets and Chain Precision Molded



Part No.	Description	Price
157083/157091		
157083	9 teeth sprocket, 1/8" bore	\$1.49
157091	20 teeth sprocket, 1/4" bore	\$1.95
157075	Drive chain (12'L)	9.95

48 Pitch Gears

Part No.	Description	Price
157121	10 teeth, 3/32" bore	\$2.95
157139	24 teeth, 3/16" bore	2.95
157147	48 teeth, 1/4" bore	3.95
157155	100 teeth, 1/4" bore	4.95
157112	93 teeth, 3/8" bore for P/N 157104 (below)	4.95
157104	1/4" bore aluminum mounting hub w/ set screws	3.95

Robot Accessories



Part No.	Description	Price
157198/157201		
157198	1/8" bore bronze wheel bushings for P/N 157219 (below)	\$1.95
157201	1/4" bore bronze wheel bushings for P/N 157198	2.19
157171	1/4" x 5.75" axle shaft	4.95

Robot Wheels (Steering & Drive)

- Extremely high traction foam rubber compound
- For surface use only
- P/N 157219 size: 2.5" x 1"
- P/N 157227 size: 2.5" x 2.0" • 2 pack

Part No.	Description	Price
157219	For 1/8" wheel bushing	\$19.95
157227	W/locking hubs for .25" shaft	24.95

Test Equipment

Tektronix Analog Oscilloscope

Reconditioned Offers upgraded performance, improved trace quality, easier maintenance and greater operator flexibility.

- Bandwidth: 100MHz • 2 input channels
- Dual (delayed) time base
- Includes 2 10x voltage probes and instruction manual

Part No.	Product No.	Price
155993	465B	\$874.95

BK PRECISION

Power Supply

Reconditioned

- Output: 0-50VDC @ 2A
- Weight: 11 lbs.
- Size: 4.7"W x 12.0"D x 6.8"H

Part No.	Product No.	Price
156013	BK1611	\$399.95

HEWLETT PACKARD

General Purpose DC Power Supplies

Reconditioned

- Constant voltage/current operation
- Remote sensing and programming
- Front and rear output terminals
- Floating output - use as positive or negative source

Part No.	Output (V)	Output (A)	Price
156363	0-20	0-3	\$399.95
156347	0-10	0-10	489.95
156380	0-40	0-5	749.95

HEWLETT PACKARD

Function Generator

Reconditioned

- Aberrations: <10%
- Frequency range: 0.1Hz-13MHz over 8 decade ranges • Impedance: 50Ω ±10%
- Size: 8.4"W x 14.8"D x 4.0"H • Wt: 13 lbs.

Part No.	Product No.	Price
156312	HP3312A	\$899.95

JAMECO Modular Oscilloscope Probes

- Standard BNC male connector
- Alligator clip ground wire
- Hook and pointed probe • 5' cable
- Max: 600VDC • Weight: 0.3 lbs.

Part No.	Product No.	1-9	10-24
66149	LF210 (100MHz)	\$29.95	\$26.95
22891	LF189 (60MHz)	19.95	17.95

Pomona® Accessories

Oscilloscope Probe Set

These general purpose oscilloscope probes feature high performance for greater flexibility.

- Risettime: 3.5ns
- Attenuation: X10 • Capacitance: 9.5pF
- Input resistance: 10MΩ • Length: 48"
- Bandwidth: 100MHz (-3dB)
- Compensation range: 10-60pF
- Complete accessory kit included

Part No.	Prod. No.	Description	Price
156443	5795A	X10 probe kit	\$34.95

Basic Electronic DMM Test Lead Kit

Kit contains 2 each (black/red)

- 48" leads
- Test probes w/ silicone insulated leads (banana plugs on meter end have no sleeve)
- Slide-on extended tips and alligator clips
- Fits most multimeters and other equipment with banana jacks

Part No.	Prod. No.	Description	Price
155942	5672A	Test lead kit	\$22.95

Maxigrabber® Cord Kit

• Kit contains 10 pcs. one each of ten colors: black, brown, red, blue, orange, yellow, green, violet, gray & white • 24" leads

Part No.	Prod. No.	Description	Price
156494	5523	Patch cord	\$29.95

Minigrabber® Test Clips

To Straight Sheathed Banana Plug

- 18 AWG silicone insulated wire
- 48" leads
- Rating: 1000V, 5 amps per IEC1010-2-031 CAT III P2

Part No.	Description	Price
156398	Test clip black	\$6.95
156401	Test clip red	6.95

Test Lead Holders

• 155985: Max cable dia.: 0.210"

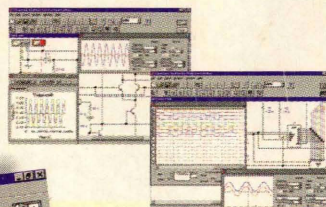
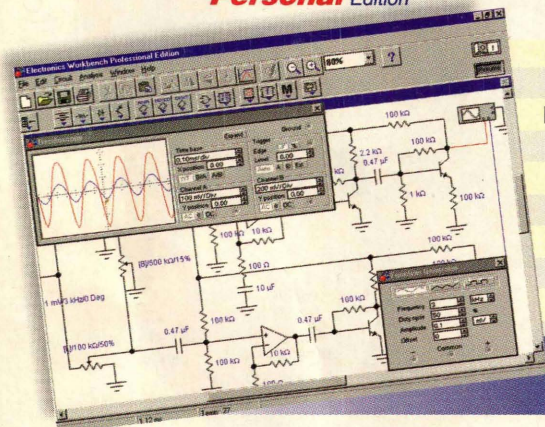
• 155977: Max cable dia.: 0.320"

• 155985: Max cable dia.: 0.450"

Part No.	Color	No. of Slots	Price
155985	Blue	9	\$5.95
155969	Black	10	5.95
155969	Orange	14	5.95

THE WORLD'S MOST POPULAR DESIGN TOOL CHOSEN BY OVER **100,000 USERS!**

Electronics **Workbench** *Personal Edition*



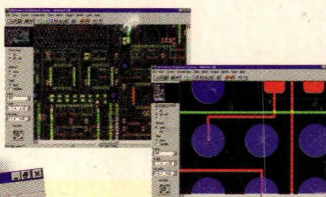
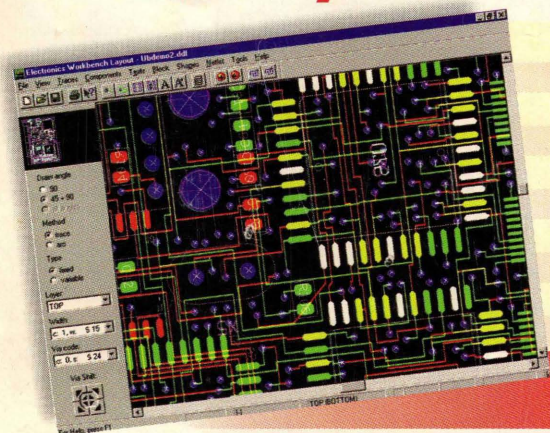
TRUE MIXED ANALOG/DIGITAL
FULLY INTERACTIVE SIMULATION
PRO SCHEMATIC EDITOR
6 VIRTUAL INSTRUMENTS
ON-SCREEN GRAPHS
OVER 4,000 MODELS
8 POWERFUL ANALYSES
FREE TECHNICAL SUPPORT

\$299

Full-featured schematic capture and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.

Electronics **Workbench Layout** *Personal Edition*

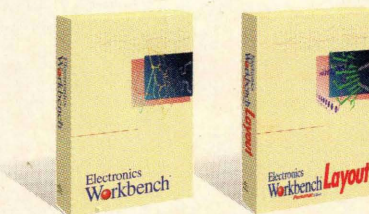


AUTOROUTING
REROUTE WHILE MOVE
32 ROUTING LAYERS
50" X 50" BOARD SIZE
OVER 3,500 LIBRARY SHAPES
EXTENSIVE OUTPUT
REAL TIME DESIGN RULE CHECK
DENSITY HISTOGRAMS
FREE TECHNICAL SUPPORT

\$299

Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.



BUY BOTH AND SAVE! ~~\$598~~ \$548

CALL FOR INFORMATION
AND PRICING ON OUR
PROFESSIONAL EDITION.

800.263.5552

30-DAY MONEY-BACK GUARANTEE

Fax: 416-977-1818

E-mail: ewb@interactiv.com



For a free demo, visit our website at **www.electronicworkbench.com**